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Forthcoming Events.

AUGUST 2, 3, AND 4.
British Foundrymen's Association.—Annual Convention at Manchester.

SEPTEMBER 27, 28, AND 29.
Iron and Steel Institute.—Autumn Meeting at Buxton, Derbyshire.

NOTES AND COMMENTS.

Exhibitions of Foundry Work.

It was with considerable interest that we inspected the exhibits of foundry work (particulars of which are given in another column) which the Worshipful Company of Founders placed on view last month at Ironmongers' Hall. Many of the items shown were the competitive exhibits for which the Company had awarded prizes, and it must be admitted that some specimens of clever work and design were shown. But nevertheless, it was with a sense of disappointment that we noticed the great predominance of small art work, and the very poor show of what might be termed utility castings. Exception must certainly be made in the cases of the exhibits under Section F, which embraced designs (drawings, models, or patterns) for any kind of cast metal work. Under this heading were shown, amongst other things, a design for a rain-water head, a design for a park entrance, a design for a set of door furniture, hardwood patterns and coreboxes complete for a 50 m.m. carburettor for an internal combustion engine, a model of a marine type, non-condensing, double-acting, vertical engine with reversing gear, a model showing the method of obtaining a casting of a worm wheel, and a wood pattern of an intercepting valve for a steam wagon.

Section D also showed three bell castings, and Section E, a few designs for cast railing, but apart from these the exhibits were practically all of a decorative or ornamental character. As representing that side of the foundryman's craft such exhibits are very commendable, but these do not represent the foundry work which is the mainstay, and the really important part of our founding industries. We realise, of course, that the Worshipful Company of Founders was formed in the early days, more with the idea of protecting the art-metal foundry trade than of furthering the technical development of the trade as we know it to-day, and it is scarcely surprising that the old traditions cling still closely. But it may well be asked, without any disrespect to the commendable efforts of the Founders Company, whether there is not room for a similar competitive exhibition embracing rather the work of the engineers' founder, for instance, and similar work, than the art metal work which concerns only a small proportion of our foundry craftsmen. This appeals to us as being more likely to further the interests and development of technical ability and initiative amongst our foundry workers, and under the supervision of some such authoritative body as the Founders Company, should elicit the approval and support of a wide circle of our progressive foundrymen. We understand, however, that the Founders' Company, while being open to receive exhibits of the class we mention, restrict these to products of the crucible. Such exhibits as Cunarder stern-frames, of course, would obviously not figure on the list of possible competitive exhibits, but there are a host of important castings which are being made from the cupola and the steel furnace which might well be shown, and which would be more representative of the British foundry trades than a

collection of art and decorative work. The brass foundry, also, produces from its crucibles a great variety of engineering castings, representing a class of work which is of great importance industrially—a class of work which certainly should appear in any foundry exhibition. A competitive exhibition of this nature may be more suited to the British Foundrymen's Association, which now probably better represents the education and advancement of the worker engaged in the general run of commercial foundry work, than do some of the older institutions, but whoever might undertake the organisation of such a scheme, it is well worth more than passing consideration.

Where Britain Lags Behind.

Writing on the subject of moulding machines in the foundry, a correspondent touches upon a curious fact, viz., that the great majority of moulding machines that are installed in our foundries are of foreign make. It is only too true that the slowness of our foundrymen to adopt machinery is reflected in the fact that, although this country ranks as one of the most important machinery-producing countries in the world, the majority of the foundry moulding machines here used are not of British make. Referring to a standard authority (Rylands' Directory of the Coal, Iron and Steel, and Engineering Trades) we cannot find more than fifteen actual makers of such machines in Great Britain, and of this number several are only makers of hand-power squeezers; but American and Continental makers are fairly well represented here. With one or two exceptions, there is amongst British makers a striking lack of enterprise and progress in the manufacture of the larger and more powerful machines, such as are being developed in America continually, particularly in view of the activities and advances that are recorded by our engineers in other directions of machinery construction. It is hard to account for this condition of affairs, though it may have resulted largely from the apathy with which, until recently, such advanced appliances as moulding machines were regarded in our foundries. Before anything like a reasonable demand for the machines existed in this country, in America, perhaps owing to the strenuousness of competition in foundry work, they came into quite popular demand, with the result that advances were continually being made in designs, and the construction of the machines developed comparatively rapidly. Now that the British foundryman is becoming alive to the importance of reducing working costs by the application of machinery, he not unnaturally casts an approving eye on the machines that have won approval abroad. This, combined with the pushfulness of the foreign maker in placing his apparatus prominently before possible users, has somewhat overshadowed the merits of British machines; though it must be admitted, nevertheless, that our makers are rather slow in meeting the users' requirements. But this condition of things cannot be expected to last long. It is not in the nature of things that this country should long lag behind where machinery is concerned. The last two or three years have witnessed great advances in moulding machine construction, and before long we should be in a fair way to supply all our own demands—and possibly, also, some of the demands of the foreigner. We essentially are not given to "hustling," but we have a way of "getting right there" in most things, and it is to be hoped that in the particular matter under discussion we shall soon justify our reputation as a machinery-producing country.

The Inventor of the Open-Hearth Steel Making Process.

On Thursday, June 9, in Paris, at a gathering representative of the steel-making interest of all Europe, tribute was paid to a metallurgist whose name is associated with the greatest steel-making process in use to-day. The occasion was the annual dinner of the Comité des Forges de France, and the guest of the evening was M. Pierre Blaise Emile Martin, of Siemens-Martin steel fame. There is a strong touch of irony in the history of Pierre Martin, for while the introduction of open-hearth steel has revolutionised the steel trades of the world, this inventor received as his reward for the service rendered to those trades what was little more than ruin and oblivion. Pierre Martin was born at Bourges, France, on August 18, 1824, and when his father, Emile Martin, purchased the Sireuil Ironworks, Charente, in 1854, he appointed his son Pierre to the management. At these works the latter experimented in steel-making, and in 1861, with the aid of his brother Emile, he developed the process of steel manufacture in the open-hearth. It was not, however, until the Siemens regenerative furnace was developed to obtain the necessary high temperature, that the Martin process was practicable on a commercial scale, but this was accomplished in 1865, when M. Martin's efforts were crowned with commercial success. Previous to that, however, other eminent metallurgists had been experimenting on similar lines, and when M. Martin came to patent his process he found the application opposed on all sides, and could not maintain the validity of his patents. The new process met with considerable success, and was adopted in a number of French works, while Martin was also awarded a gold medal for exhibits of his products at the Paris International Exhibition of 1867. But in legal actions to establish his rights to the patents, and in resisting infringements, the inventor spent all his fortune, until he was quite impoverished. Then, quite disheartened by the failure to maintain his rights, he disappeared from the metallurgical world. During his retirement the process M. Martin had invented gradually attained the success which is now a matter of common knowledge.

A Belated Recognition.

Though the Siemens-Martin steel had attained such importance and prominence, Pierre Martin himself was practically forgotten, until he was discovered about six months ago to be living in very straitened circumstances, near Nevers, Central France. As soon as the fact became known, the Comité des Forges de France decided to start a fund in order to afford some reparation to the aged metallurgist (now in his 86th year), for the disappointments and hardships he had undergone, and headed the list with £4,000. The German Ironmasters' Association contributed £1,600, while Belgium, Italy, Austria-Hungary and other steel-making countries also contributed. In this country the initiative was taken by the Iron and Steel Institute, and the strong committee formed included the Duke of Devonshire (President of the Institute), Sir Hugh Bell, Mr. C. J. Bagley, Mr. W. Beardmore, Mr. Illtyd Williams, Mr. G. Hatton, and Mr. M. Mannaberg. The amount subscribed up to the present is about £940, the total contributions amounting to over £8,000. At the presentation ceremony held in Paris, last month, M. Eugene Schneider, of the Creusot Works, Vice-President of the Comité des Forges, presided, and among those present were M. Millerand, Minister of Public Works, who attended on behalf of the French Government, Prof. le Chatelier, Mr. G. C. Lloyd (Secretary of the Iron and Steel Institute), Herr Schrödter, of the

German Ironmasters' Association, and M. Greiner, Director of the Cockerill Works, Seraing, representing Belgium. M. Schneider, in making the presentation, referred to the great services which M. Martin had rendered to the iron and steel industry, and M. le Chatelier alluded to the work done both by Martin and Siemens, pointing out that it was the evolution of the Siemens furnace which made possible the success of the Martin process. M. Millerand, on behalf of the President of the French Republic, presented M. Martin with the Cordon of the Legion of Honour. A silver medal was also presented to him as a souvenir of the occasion.

Thus, after years of disappointment, public recognition is made of a great service rendered to a great industry. It is pleasing to find the movement supported so unanimously, but one cannot help feeling considerable regret that such recognition can only now be made at the close of the inventor's life. The case presents a marked contrast to the success which attended Henry Bessemer, the inventor of what may be termed the rival to the open-hearth process. He not only was duly acknowledged and honoured as a great metallurgist, but he also reaped an appreciable amount of pecuniary reward from the application of his process. Fortune is truly a fickle jade.

The Advantages and Disadvantages of Using Scrap Brass.

In every brass foundry a more or less large quantity of scrap is produced in the form of sprues, gates, feeding heads, risers, etc., and also occasionally as bad castings, and as this scrap is generally good, clean metal, it goes straight back to the pot for further use. There is little trouble encountered in melting this for the general run of work, as there is practically no dirt in it, and the composition is known approximately. The quantity of such scrap obtained in the course of a day's work is considerable, so it must be used up continuously. There is, however, some difficulty in dealing with this material, if a run of castings are to be made of uniform composition, since some of the zinc is lost at each remelt—proportionately much more than of any of the other constituents—and when the quantity of scrap put into the pot is large, and no account of this loss is taken, the composition will not conform to requirements after a few melts. Zinc volatilises at 1,652 degrees Fahr., a temperature easily obtained in brass melting, and according to the conditions the loss of zinc through oxidisation and volatilisation will vary considerably. In working for a standard alloy, then, the services of the chemist are practically indispensable. The furnace conditions must be kept as constant as possible in order to avoid much variation in the zinc losses, and then the loss during the melt must be ascertained so that sufficient zinc can be added in remelting the scrap to get the correct composition. It is then possible to charge the crucible each time with the correct amounts of each constituent. It will, of course, be understood that the losses of the other constituents also must be ascertained, the requisite being rather the determination of the relative losses of the component metals than the loss of any particular one.

The control and handling of other scrap is a more difficult matter; so much so that any but good, clean metal should not be used for standard work. The losses incurred in melting turnings and chips, even from known alloys, are so variable that the material is scarcely good enough for first-class work, and when outside scrap and turnings are used the case is worse still. In using the latter class of material it is good practice to run the metal into ingots first, in which form its composition can be better determined. But it should be remembered that it is almost impossible to buy scrap that is quite free from iron in some quantity. This makes it awkward stuff to use for work that has to be machined, as the iron not only renders the brass hard, but is also liable to occur in extremely hard spots, which will resist the machine tool. Owing to the increasing use of aluminium, that metal also frequently occurs in scrap brass, and though a very desirable constituent in some alloys, very frequently results in dirty castings when present in unknown quantities in scrap. On account of these features foreign scrap is not suitable for good work.

Despite the drawbacks mentioned, however, the use of scrap metal has important advantages. Owing to the presence of the zinc and other constituents with low melting points, this material melts quicker than the copper ingots charged with it, and if the scrap is placed in the bottom of the crucible it forms a body of molten metal into which the new copper falls as it melts down. The zinc present deals with the oxide of copper formed in the melting, while the scrap may also be added at intervals to prevent overheating the mixture. It also assists in melting the copper, thus reducing the time employed and the chances of oxidisation. It will be seen, then, that scrap metal is distinctly useful, and for general work is often preferable to a charge of all new metal.

Association Technique de Fonderie.

A meeting for the constitution of the above Society of French foundrymen was held on Friday, June 17, at the Hôtel des Chambres Syndicales, Paris. Amongst those present were:—MM. Eissen-Piat, Tissot, (Paris-Outreau); Roger (of the firm of Muller & Roger); Ronceray, Masson (Nancy); Lebel (Amiens); Barthe, Thivet-Hanctin, Dellys, Huot, Bermond (Dôle); Plichon, Garry, Decollogue, Poinsat, Passot (of the firm of Renault); Jouve, Allais, Thuau (Rennes); Rivière (Quimperlé); Saillot, Bonvillain, Bouchilloux; Dubois (of the firm of Lepet), and others.

A number of names were received by the Secretary for membership, amongst which were the following:—M. Dreux (Aciéries de Longwy), de la Société de Commentry-Fourchambault, Thomas (Soissons), Magnard (Fourchambault), Haller (Villerupt), Fabre (Maubourguet); Roussia, Arthur Martin, Wencélius, Lamberton (Merzweiler, Alsace), Brasseur (Luxemburg), Pralon (Administrateur of the Société Denain et Anzin), Grosjean (Nancy), etc., etc.

The assembly was presided over by M. Roger, assisted by MM. Tissot, Masson and Ronceray. The Secretary presented an address on the proposed rules of the Association, which was unanimously approved. It was then decided to elect a Committee, who would hold office until the approaching general meeting, and who would undertake (1) the draughting of the rules; (2) the promotion and acceptance of members; (3) the organisation of the forthcoming meeting, and the Congress to take place at Paris; (4) the preparation for the election of officers and the final committee. The meeting unanimously nominated M. Barthe as President, M. Roger as Vice-President, and M. Plichon as Treasurer. The following gentlemen were elected as members of the Committee:—MM. Tissot, Eissen, Masson, Ronceray, Bermond, Dellys, Lebel, Thomas, Brasseur, Lamberton, Thuau, and Rivière.

Application for membership may be made to any member of the Committee, and correspondence should be addressed to M. Didier, the temporary secretary, at 61, Cours d'Orléans, à Charleville.

Cylinder Moulding for Railway Engines.

At a meeting of the Birmingham Branch of the British Foundrymen's Association held on Saturday, May 28, at the Municipal Technical School, Birmingham, Mr. R. Mason (Local President) in the Chair, a lecture was given by Mr. H. Pemberton, of the Midland Railway Company's Works, Derby, on "The Moulding of Cylinders for Locomotives." The lecture was illustrated with interesting views of the Midland Railway Company's works.

Mr. Pemberton's address was as follows:—

Of all the castings that are used in engineering, I consider that there are none requiring more careful work than the engine cylinder. Hydraulic castings, turbines, compressed air work, flywheels, etc., all need their share of attention, but not one of these, I think, needs more work than the cylinder. The locomotive cylinder is subject while doing its work to a great deal of oscillation and vibration to which a stationary cylinder is not liable. The matter is further complicated by the position in which the cylinders of a locomotive are compelled to be placed, which is either outside the engine frames or in the centre of the engine front. This exposes the cylinders to the keen wintry winds and frosty air. These are among the considerations which make the casting of locomotive cylinders the most important work in the foundry.

In the production of locomotive cylinders, or of any other cylinders of which there is to be a large quantity made, the pattern has to be considered very carefully. Very often a sovereign spent in pattern-making saves many times that amount in moulding. The pattern is made with numerous loose pieces, which entails extra cost. I will not dwell upon this matter at present, but will shortly show a few of the cavities left in the mould from which the loose pieces of the pattern have been drawn. The moulding boxes also require special attention to enable the moulder to make his part of the job as simple as possible. Therefore, one moulding box is made to suit a variety of cylinder patterns—that is, a plain box is made with holes cast in the side or the central part of the cylinder, and by having a number of loose bars of various shapes which fit around the different sizes of the cylinder patterns and bolting them to the sides of the moulding box, the moulder is helped and is saved the necessity of putting lifters or gaggers into the mould, while at the same time the job is made much firmer and stronger.

There are several types of cylinders in use on the railway, but I propose to deal only with the three which are in most common use. These are the twin cylinders, the piston valve, and the high-pressure cylinder of the compound cylinder engine.

Fig. 1.—Iron Core-Boxes on the Shell System; Core-boxes and Core-irons for core of double steam chest for twin cylinders.

Fig. 2.—Cores for One Double Steam Chest for Twin Cylinders before being put together on the frame.

The Twin Cylinders.

The twin cylinders are moulded with only one joint in the mould, but the moulding box is made in four parts for the convenience of the moulder when ramming up his mould. The two middle parts of the box are made quite plain, and into these parts loose bars are bolted, whilst the top and bottom parts have bars right across their length. One half of the pattern is first laid on a turnover board. The loose pieces are put in their places on the pattern and temporarily fastened with pins or skewers. If the cylinder is of an exceptionally uneven thickness, chills are placed on the pattern in various places. As is well known, with an iron that is required to be very close-grained and strong, contraction cavities will form, unless some preventative is used to arrest the molten metal before this has time to take place. These chills are first made hot and then dipped into gas tar so that when the mould has been cast this very thin coating of gas tar burns and forms a film of gas between the chill and the molten metal, thus preventing the metal from burning into the chill.

The facing sand for these moulds is composed first of 20 per cent. of manure and 80 per cent. of new sand. This is ground up as loam, taken into the stove and dried, and then taken back to the sand-mixing machine. Eleven per cent. of this is ground up again with 3 per cent. of manure, 83 per cent. of new sand, and 3 per cent. of coal dust. This is placed around the pattern. The moulding box, which has previously been put over the pattern, and has had bolted in the loose bars to suit the class of cylinder being made, is again placed over the pattern on the turnover board. It is now partly filled with black sand, which is used slightly damper than the black sand for green-sand work. By using the sand in this manner a much stronger mould is made. The mould is rammed up to the top of the first part of the moulding box. The second part, which has been left off for the convenience of the moulder while he rams up the first, is then placed in position, the two are cramped together and the ramming is continued to the finish of this part of the mould, which is then vented and turned over. The turning-over is done by attaching a chain to eye-bolts or rings fastened in the side of the moulding box. By having these, no rolling-over chain is required. The joint of the mould is then brushed off, the top half of the pattern is placed over the bottom, parting sand is thrown on the joints, the facing is placed round the

FIG. 3.—CORES FOR TWIN CYLINDERS AS PUT TOGETHER ON FRAME BEFORE BEING LOWERED INTO THE MOULD.

FIG. 4.—BOTTOM PART OF MOULD FOR TWIN CYLINDERS, SHOWING TWO CORES FOR SIDE OF MOULD, ONE TEMPORARILY PLACED IN POSITION, AND ONE OF THE BARREL CORES IN BACKGROUND.

pattern, and the first portion of the moulding box top part is put on. The loose bars are bolted in, and the ramming is continued to the top of this half of the top box part. Facing sand is then put on the top of the pattern, the second part of the moulding box top is put on, and the two are cramped together. A few lifters are necessary on the top of the pattern. Where the cavities exist, these are put in and the mould is rammed up to the top. I might say that as the exhaust and main steam pipe core prints come almost to the top of the moulding box in this class, the sand is cut away from them, leaving an opening for these cores to come through. The mould is parted, the patterns are withdrawn, and the mould is finished, wetted, blacked, and put into the stove to dry.

In dealing with the core-making for these cylinders, it might be interesting to point out that all the core boxes which can be conveniently made of cast-iron are of that material, and are made on the shell system, as shown in Fig. 1, which shows a few of the core boxes and core irons used for the twin cylinder. Of the core irons shown here, it will be readily seen which belong to their respective core boxes. These are all made of cast-iron, including the steamway core iron. This, I might say, is one of the most convenient core irons that I have seen. As will be readily understood, this saves a large amount of labour when fettling and dressing the casting, as it can be easily broken and taken out of the casting. It might be interesting to state that a number of these cores have a core plate made the shape of the core on which they are dried. This saves packing up with sand to prevent warping, as would be necessary with a straight plate. It is not necessary to describe how these cores are made, except in the case of the steam passage core. In this, the sand is placed to a depth of $\frac{1}{2}$ in. in the shell, and the core iron is clay-washed and bedded in the sand. A little more sand is put on, and wax wires are laid in about $1\frac{1}{4}$ in. apart, and through the holes in the end of the shell. The top half of the box is then bedded on the sand, and the core is rammed up from the sides as far as possible, which are left open for that purpose. It is impossible conveniently to strickle these cores as they have several radii. The barrel cores are struck up in the ordinary way as shown in Fig. 2. These are the cores which go together to form the double steam chest along with the steamway, exhaust, and main steam pipe cores.

I will now endeavour to describe how these cores are put together to form one united core before entering the mould. To put these cores together in the first place, we have a square frame made about 8 in. larger than the outside of the moulding box. On this, one half of the steam-chest core is laid, the steamway or port core having had its tie wire threaded round the core iron. The wire is then passed through the core print in the steam-chest core, the steam-port core is put into the print and secured by tying the wire around the piece of quarter-inch iron which is bedded in the back of the steam-chest core. The core-print in the steam-chest core is made one-quarter of an inch wider than the steam-port core, and the steam-port cores are set to the outside edges of these core prints. This is done to enable the moulder to ram sand in this quarter of an inch of space. By doing this, the steam-port core is made very firm, and thus no stud or support is required between the steam-port core and the steam-chest core.

FIG. 5.—CORES TO FORM ONE VALVE CORE FOR THE PISTON-VALVE CYLINDER.

Of course, a thickness piece is laid on the steam-chest core when the steam-port core is first put in the print, but this is taken away when the port core is secured. The four steam-port cores having been fastened in their core prints in the two halves of the double steam-chest, the two halves are then bolted back to back on the frame, as shown in Fig. 3. The exhaust cores are next fitted into the prints provided in the steam chest cores, and a hole is bored through the exhaust cores and the double steam chest. A piece of tie wire is threaded through all the cores, and they are all fastened together by twisting this tie wire round a piece of quarter-inch iron which has been bedded in the

exhaust cores. This secures them on the bottom, and they are finally fastened on the top of both cores by fastening a piece of tie wire round the piece of projecting core iron left for that purpose. The barrels are next put on the frame. Then the main steam-pipe core is put into the prints left in the steam-chest core, bolts having been cast in the steam-pipe core iron. This is bolted up to the steam-chest, and the arrangement also serves the purpose of bolting the halves of the double steam chest together on the top.

Everything is now securely fastened together and provision made for the air to escape. The inside of the cylinder which is complete on the frame, is lowered into the mould, the frame dropping over the moulding box and the cores into the core prints. Fig. 4 shows the bottom part of the mould before the inside cores are lowered into their prints. Two cores are made for the side of the mould. These are

The Piston Valve Cylinder.

Referring to Figs. 5—8, the piston valve cylinder shown is that one that has two joints in the mould. The pattern is treated similarly to the twin cylinders pattern, and the mould is rammed up as before, except that a number of loose irons and lifters are required in the bottom part of the mould to support and strengthen the pockets of sand which would be left when the pattern is withdrawn. The first joint of the mould is made in the centre of the piston valve, and the second at the centre of the cylinder barrel. The middle and top parts of the mould are rammed up just as with the twin cylinders. In Fig. 5 is shown a set of cores which together form one piston valve core. These are assembled or put together first upon a pair of trestles, the two halves of the valve or body being joined together after the grooves, which

FIG. 6.—BOTTOM PART OF MOULD FOR PISTON-VALVE CYLINDER, SHOWING ONE OF THE VALVE CORES BEING LOWERED INTO THE PRINTS.

put into their prints and, held back by screw hooks which are passed through holes cast inside of the moulding box for that purpose. The top half of the moulding box is lowered over the bottom, the whole is cramped together, the chaplet which has been placed over the elbow bend in the main steam-pipe core is held secure, and the mould is again placed in the stove to take away any moisture which has been used in putting these cores together. Next day the mould is brought out of the stove, and the runner and riser boxes are made up in the usual way. Pieces of tinplate are placed over the runners. These gently melt as the metal is poured into the box; the runner box is easily filled, and the rush of metal into the mould is not so sudden as it would be if loam stoppers were used. These moulds are cast warm.

are cut in the cores when green, have been made clear for the passage of the air. These two half cores are bolted together at the end. The provision made in the core iron for the bolts can be seen.

The steam-port cores, which are made in two halves, are fitted into the core prints in the valve core and are tied together at the bottom and at the top with tie wires. This set of cores, now made one, is picked up by means of a beam and two rope slings. We use these rope slings because there is not so much danger of them slipping, as rope is more pliable to clasp round the core iron. Thus, a large amount of vibration is avoided, as well as danger of the sling slipping and causing a sudden jar on the core, while it is in the crane. Fig. 6 shows a core which has been put together on the trestles being lowered into the mould. The second core,

which has been similarly made and assembled, is put into the mould by the side of the first, the exhaust portion and that part where the main steam pipe rests coming back to back when these two cores are placed in position in the mould. The middle part of the mould (see Fig. 7) is placed over the bottom part and the barrel cores, which are made as usual, are then placed in their prints. The cores which are made for the side of the mould are put into their prints and held back by means of screw hooks. Fig. 8 is a view of the top part of the mould showing the steam-pipe cores, exhaust core, and one of the side cores. The steam-pipe core is made in two halves. These are fitted into their prints, which are in the top part of the mould, and fastened up with screw hooks and bolted together where they meet at the bottom. The exhaust core is also fitted into the core print in the top part of the mould and fastened up by means of a screw hook. The steam-

show a set of core boxes and core irons, and the core as it is finished ready for going into the mould. In Fig. 9 it will be noticed that the two core irons for the valve core are not exactly alike, although probably at first sight they would be taken for the same irons, the one on the left side having three feet. These feet are where the steam pipe rests. The other core iron goes into the box on the right. The cores made up of these boxes are assembled on a pair of trestles. When the usual provision for the air has been made, the two halves of the valve chest are bolted together at the ends. Then the four halves of the steamway cores are fitted into the prints provided in the valve chest for that purpose. These cores are tied together at the bottom and also at the top, and having thus been made into one complete core are lowered into the bottom part of the mould. Fig. 10 shows the bottom part of the mould with the core in position. Fig. 11 shows the

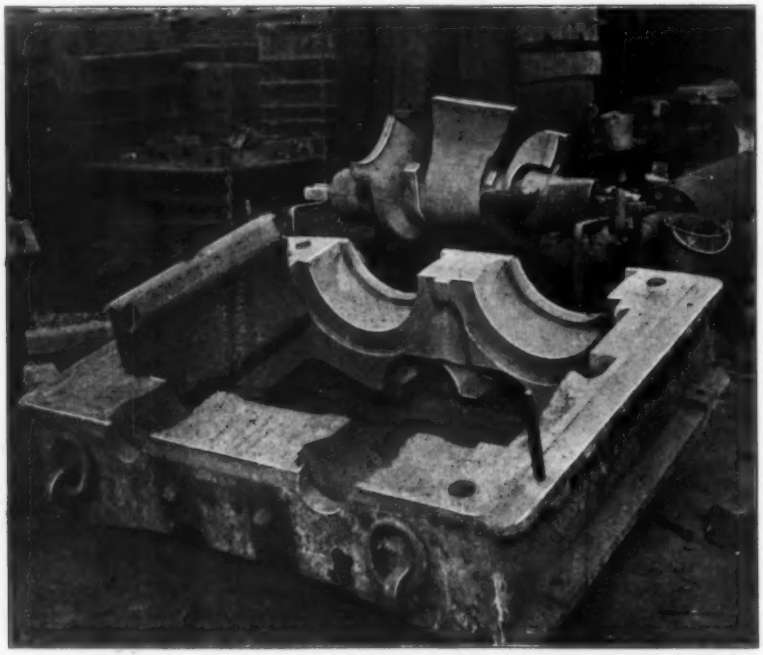


FIG. 7.—MIDDLE PART OF MOULD FOR PISTON-VALVE CYLINDER; ONE OF THE SIDE CORES TEMPORARILY IN POSITION, AND ONE OF THE VALVE CORES IN BACKGROUND.

pipe core is then temporarily packed to the side of the mould and the top turned over. The packing is then taken out. The top part is lowered on to the middle part, and the whole is cramped together and put into the stove until next day, when it is taken out. The runner and riser boxes are made up and the mould cast as usual.

The High-pressure Cylinder of the Compound Cylinder.

The high-pressure cylinder of the compound cylinder is a casting that is moulded with two joints in the mould. The first is at the centre of the valve chest, and the second at the centre of the cylinder barrel. After the details of moulding given in connection with the two cylinder castings, it is not necessary to describe the moulding of this one. I will, therefore, proceed to

middle part of the mould with the steam pipe core, two cores for the side of the mould, and a core for one end of the mould. This core for the end is made to avoid having so many loose pieces of a pattern congregated together. The middle part of the mould is next lowered on to the bottom. The cores for the sides are then put into their prints and held back as usual. Next the barrel core and then the steam pipe core are put in. The latter is difficult to put into the mould. It is fitted on to the two feet of the valve core, and a nut is placed between the barrel core and the steam pipe. A piece of wire is fastened to this nut, passed through the space or thickness at the side of the neck of the pipe and temporarily fastened to the top of the core. Now, as the top part of the mould is being lowered on to the middle part, one of the moulders gets on to the top of the

mould. After the core for the ends has been put into the core print in the top part and held up by means of a screw hook, this moulder puts his hand through the hole of a loam cake which has been previously made round the core print when the mould was being rammed up, and as the top of the mould is lowered on, he just eases this steam-pipe core and draws up the nut which has been used to pack this core, and finally sets it up with the loam cake. Packing is put on the loam cake and the core at the print end and held down by weights. A chaplet is used to hold it down at the opposite end to the round print. The chaplet is made secure and the mould is clamped together and put into the stove until the following day, when it is taken out and cast.

In melting the metal for these cylinders, it is good practice to melt one ton of hard iron and 10 cwts. of soft iron before the metal for cylinders, this 30 cwts. of iron to be the first metal of the day melted.

Mr. Craig said that Mr. Pemberton had given them an excellent lecture, and some very fine illustrations. He did not quite understand why in the twin cylinder it was necessary to have a double parted bottom box.

Mr. Dobson mentioned some motor cylinders which were returned because they had a thin black seam which looked like carbon. The cylinders were about ¾ in. thick, and they never got any good ones till they cast them on end.

The President in inviting further discussion, said that it seemed to him that Mr. Pemberton had put things so clearly that they understood everything. Mr. Pemberton had told them what his facing sand was, but he had not told them what his core sand mixture was. Possibly he had thought that unnecessary because he had spoken on the subject when they had their discussion on core mixtures. When he (the President) was looking at the cores shown

Fig. 8.—Top part of Mould, showing Main Steam-Pipe Cores, Exhaust Core, one of the Cores for the Side of the Mould, and a few Cores which go in the Mould for lightening purposes.

We find that the following analysis suits our purpose the best for the castings :—

G.C.	2.7	Total carbon 3.5
C.C.	0.8	
Si.	1.2	
S.	not more than	0.08
P.	not more than	0.45
Mn.	0.8	

Castings made to this analysis will give a transverse test of 33 cwts., with ⅝ in. deflection on a test bar, 2 in. by 1 in. on 3 ft. centres. This metal should be melted very hot and rapidly. The more quickly it is melted, the higher the tests. In casting the moulds, the hotter the metal is poured the better will be the result in the machine shop. Castings made to the above analysis are left in the mould to cool for about 20 hours.

Discussion.

The President said that they had had a very remarkable lecture, and he hoped that Mr. Pemberton would be willing to address them again on the same subject at the coming National Convention.

by Mr. Pemberton and considered the difficulty of venting them, and the peculiar positions they were in, he could not help admiring the excellent results that were obtained. He would like to ask whether the lecturer made a point of always using core plates the shape of the core boxes to turn over. He knew that was a very good idea, but he had not used it to any great extent with large cores. With some cores of fair size a difficulty was found in drying; they did not dry quite so fast as one could wish. Another point was that the core would get in drying into a state which in Scotland they used to call "fusty." They could rub it away at the surface, though at the centre the core was quite dry. The facing sand mentioned by the lecturer as being new sand was rather remarkable. He thought some old sand would have been used as well. Perhaps they used old sand in some of their smaller work and nothing but new sand is the cylinders. The pieces of tin mentioned by the lecturer, he noticed, were ordinary black iron coated with tin. He had seen that method described in the American papers, and he thought it a very good idea. He understood

with regard to the iron used, that they took one ton of hard iron and 10 cwts. of soft iron and melted them together and poured them into pigs, afterwards

A member asked how much metal was allowed for boring and turning in the cylinders.

Mr. Shaw asked whether Mr. Pemberton had ever

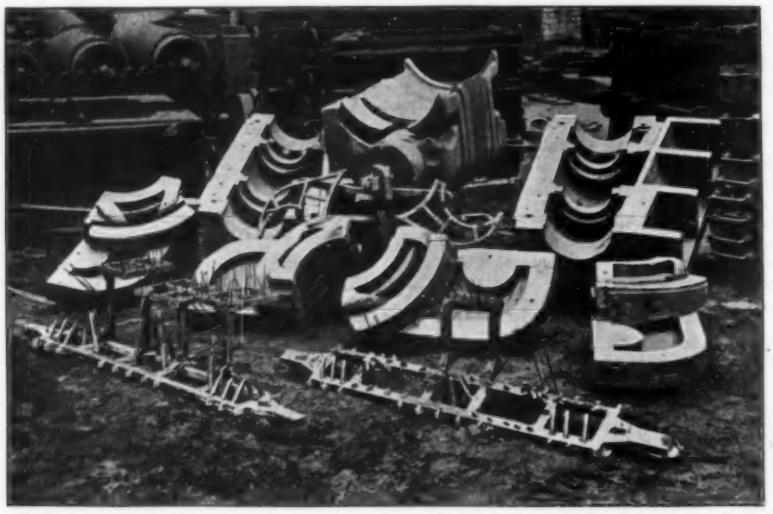


Fig. 9.—Core-Boxes, Core-Irons, and the Valve Core as it is assembled on Trestles ready for the Mould.

re-melting them and casting the cylinders. He noticed that the phosphorus in this iron was very low. Did they buy their irons by analysis? It would be very helpful to some of them if Mr. Pemberton would tell them what iron they bought in order to be able to get so low a percentage of phosphorus as 0.45 every time.

discovered that the top side of his cylinder was not clean? There was a tendency for little holes to form at the top. He did not himself see the necessity for any coal dust in dry sand work. Had Mr. Pemberton had any experience of casting the steam-port portion without any irons at all? He believed that was done in some cases.

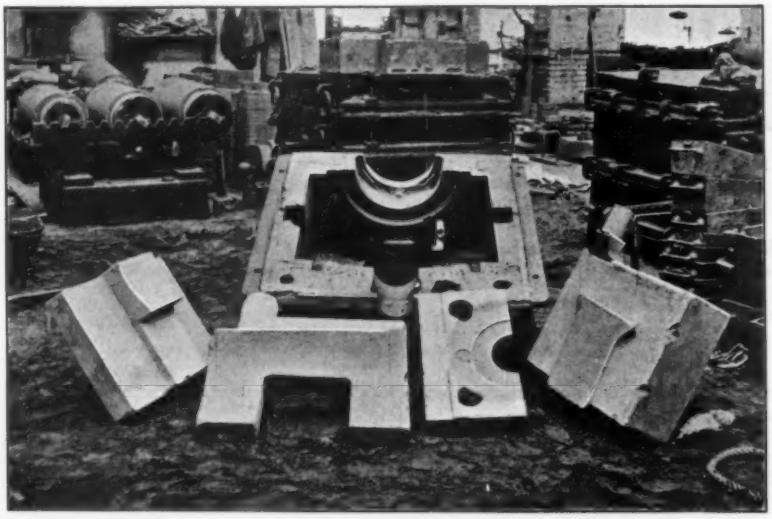


Fig. 11.—Middle part of Mould for the High-Pressure Cylinder of the Compound Cylinder, showing main steam-pipe core, two cores for side of mould, and one core for end of mould.

Another member asked what contraction was allowed on the cylinders?

Mr. Shaw wished to know, also, how much stuff Mr. Pemberton had on his main core barrels. In some cases it was possible by having the core bars as large as possible to get a very hard internal skin.

Mr. Pemberton, in reply, said that two boxes were not necessarily required for the bottom boxes of the twin cylinders, but they made the boxes in that way for the convenience of the moulder. It was a great convenience for the moulder to ram up one-half at a time, where the work was so large. If they made them in two parts they could put loose bars in the one, and there was a distinct advantage in that. What he had described as hard iron was really a common iron. They put it into common work, but they did not use it for pulleys and that sort of thing. It was a term they used in reference to the first lot of metal in the cupola. This did run hard, and they sometimes got unexpected results. With regard to the core plates being the shape of the core, it was a certain fact that some cores

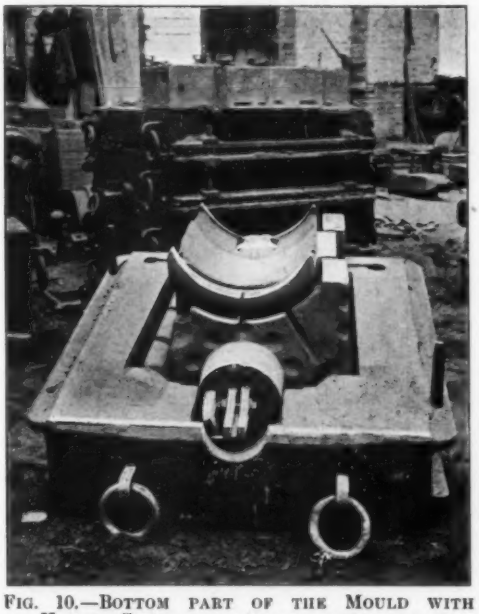


Fig. 10.—Bottom part of the Mould with Valve Core in position, for the high pressure cylinder of compound cylinder.

dried much more easily than others, and in that case this method saved a great amount of labour and prevented the core from warping. That was a distinct advantage. With regard to cores crumbling, that might be through putting a lot of old sand into the core mixture. He (Mr. Pemberton) did not recommend that. It would pay them to use new sand in such cases if they were doing a good class of work. They used the old sand in the facing sand for green sand work. There was an advantage in using it in that way rather than for cylinders, and other castings subject to great pressure. For such purposes it was of no use to introduce burnt sand into the mixture. For boring out cylinders they allowed $\frac{3}{8}$ in., or $\frac{1}{16}$ in. a side, and they found that sufficient. With regard to the cylinder being clean when cast on the side, they had very good results with theirs. Perhaps that was in the running of the cylinders. He might say that in their twin cylinders he did not think they had had one returned from the machine shop out of over 600 cylinders. All the twin cylinders were run in at the open end. Perhaps they would find that an advantage. If they ran them in there, then if there were any dirt present it had a chance of getting up the wall of the cylinder or up the back. As to keeping the casting clean, he believed that the use of the tinned plates had a great deal to do with it. He would rather use those than the loam stoppers. They would find that the rush of the metal into the moulds was not so sudden. They did not let their port cores come up to the barrel cores, but always left just about $\frac{1}{8}$ in. of clearance or flash between the port core and the barrel core. This arrangement, no doubt, saved many a cylinder. Often they did not know how near to the wind they were sailing, and it was surprising what small things would cause a scrap. He had never heard of anyone attempting to make a locomotive cylinder without core irons in the port cores, and he certainly should not try it. The contraction of their cylinders was ordinarily $\frac{1}{8}$ in. to the foot. The loam allowed on the core bars was $1\frac{1}{4}$ in. With regard to iron having as low as 0.45 of phosphorus, he was certain that if they looked round they would find quite a lot of people supplying such iron in that district.

Mr. Reason, in proposing a vote of thanks to the lecturer, said that Mr. Pemberton must have given to the subject a great deal of time and thought. With the explanations and illustrations given, it was not surprising that they had not been ready to put questions. Only people with experience of big cylinder work would be able to put questions to Mr. Pemberton on all the matters he had explained to them.

Mr. Heggie (Hon. Sec.) seconded the vote of thanks, remarking that the lecture was one of the best that they had had. The vote was carried with hearty acclamation.

INNOVATION IN STEEL MANUFACTURE.—The Dominion Iron and Steel Company is introducing a new departure in the manufacture of steel at its plant in Sydney, Nova Scotia. The Company is building two 500-ton rolling basic open-hearth furnaces preparatory to what the Company's engineers call a quadruplex process, counting separately the last reaction following the additions in the ladle after the metal is tapped from the final or third furnace. The new 500-ton furnaces are 58 ft. between ports and 21 ft. 6 in. wide. They will desiliconise direct metal from the blast furnaces, with scrap and limestone additions. When one of the large furnaces has been filled and the silicon has been sufficiently eliminated, the metal will be all poured in from 16- to 18-ton heats, and blown in basic-lined converters a sufficient time to dephosphorise it, from four to six minutes being required. The blown metal is then charged into a 50-ton rolling open-hearth furnace, some direct metal being also added. The final recarburising additions are made in the ladle, which is kept at a very high temperature at the time of tapping. The process contemplates that when one of the large furnaces is being emptied the other is being filled. It is considered possible by this process to get 60 to 70 heats a week from a 50-ton open-hearth furnace. The equipment of the new open-hearth furnaces includes a 75-ton double trolley ladle crane and a charging machine.

The Shockless Jarring Machine.*

By Wilfred Lewis.

The jarring machine is essentially a sand-packing machine, capable of ramming any mould, large or small, in a minute or less time. By the method employed, the sand is rammed as it should be, densest at the surface of the pattern and of decreasing density above, thus favouring the escape of gases when the mould is poured. The packing of the sand results from impact between the table on which the mould is carried and the anvil on which it drops. Various means may be used to lift the table and let it drop, but in foundry work compressed air has come to be generally preferred for its convenience as a medium for the transmission of power, and also for the simplicity of the machines resulting from its use. The jarring machine is not universal in its application, nor should it be used without judgment and discrimination. Due regard must be given to the construction of the pattern so as to permit a flow of sand chiefly in one direction, and to withstand successfully the shock of impact in ramming. But, for the broad field of work adapted to its use, there is nothing comparable to the jarring machine as a saver of time and money. Jarring machines have been in practical use for many years without attracting much attention, but they have never been made, until quite recently, for large heavy work beyond the strength of one or two men to handle.

FIG. 1.—GENERAL VIEW OF THE SHOCKLESS JARRING MACHINE.

It must be admitted that although the packing of sand by the jarring process is very quick and effective in producing results, it is not very efficient under the most favourable conditions, as far as the expenditure of power is concerned, and that under certain conditions the efficiency may be reduced to zero. In the process of ramming, the density of sand is increased 25 or 30 per cent., and if a steam indicator were attached to the cylinder of a power squeezer, it may be questioned whether it would ever show over 1,000 ft.-lbs. per cubic foot as the work actually done on the sand in squeezing it to proper density. Of course, a great deal more power than this would be consumed in the use of water or air as a working fluid, but the work put into the sand would in all probability not exceed 1,000-ft.-lbs. per cubic foot.

To produce the same effect by jarring, the sand might be raised to a height of 4 in. and dropped upon an anvil 30 times; but to the weight of the sand must be added the weight of the table and flask, and the excess sand used as an aid in ramming. The first blow struck will cause the greatest flow of sand and will do the most work upon it, while each succeeding blow will increase the density and do less and less work, until, after a certain number of blows, the sand will remain at a density corresponding to the drop. When this point has been reached, the continued action of the jarring machine simply wastes power and produces no effect. The jarring machine is therefore more efficient during the earlier stages of the process than it can be when the condition of maximum density is approached; and for this reason, the longer the stroke the greater will be the efficiency. Other considerations of a practical nature, affecting the elasticity or durability of flasks and patterns and of the machine itself, necessarily tend to limit the stroke, however, so that in practice it varies from $\frac{3}{8}$ in. on some machines to 4 in. or more on others, with an average of perhaps $2\frac{1}{2}$ in.

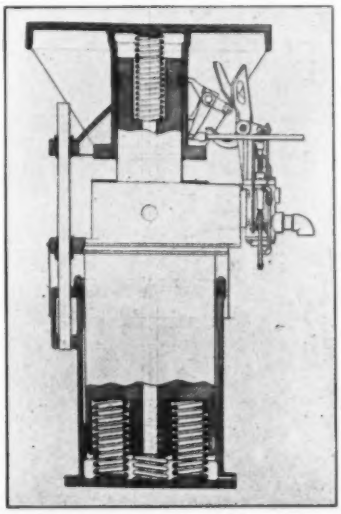


FIG. 2.—SECTION OF JARRING MACHINE.

In such machines the most important consideration is solidity of construction and freedom from vibration of the jarring table. Otherwise the sand will become broken or laminated and the mould will be liable to fall apart in handling. Although lightness of construction in the jarring table is obviously desirable from the standpoint of economy in power, it is cer-

* Abstract of Paper read before the American Foundrymen's Association, Detroit Convention, June, 1910.

tainly not desirable from the standpoint of making perfect moulds.

In the moulding machine to be described, the table adopted has been formed in one piece with the jarring cylinder, as shown in section in Fig. 2. This table has great depth of beam, and the metal is distributed, as it should be for economy of cast iron, in a broad expanse of plate on the tension side, and a smaller mass around the cylinder on the compression side, where the blow is struck. Radial ribs connect the tension and compression sides of the beam, forming a table of enormous strength and stiffness to distribute the central blow of impact equally in all directions. A table of this type is really stiffer than some of the anvils on which other tables are made to drop. At any rate, there is no perceptible vibration of the table when it strikes its anvil, or rather the buffer ring of leather or other non-resilient material interposed to relieve the sharpness of the blow and to reduce the noise. This buffer also helps to reduce vibration and rebound, by reducing the intensity of the force of impact. It is not, however, the rebound of the table from its anvil that injures a mould, so much as the rebound of the flask and sand from the table. Solidity of contact between table, pattern board and flask, is one of the most important elements for the successful working of a jarring machine; yet this detail rarely receives the attention it deserves, and not unfrequently the machine is condemned for this reason, which is no fault of its own.

Unlimited power may be expended in jarring sand to any given density; and since there is a certain maximum density corresponding to any given drop, it is also quite evident that efficiency increases with the drop, and decreases with the dead weight handled over and above the weight of sand used. But a certain amount of dead weight is inseparable from the process, and for this reason a heavy machine may not be used to its best advantage on light work. Nevertheless, with air as a working fluid the benefit gained by expansion on light work offsets to a great extent the loss from the greater proportion of dead weight carried, giving to the jarring machine which uses air expansively in its cylinder quite a wide range of capacities, under approximately uniform efficiency so far as the consumption of air per cubic foot of sand rammed is concerned.

But it is not only the air consumed in lifting the loaded table that may not be utilised to the best advantage. At the instant when the loaded table strikes its anvil, the sudden change in the velocity of the table, whatever that may be, measures the pressure of impact, and the ramming effect is measured by the square of that change in velocity, which is proportional to the energy absorbed, part of which is utilised in ramming sand. Therefore, the greater the change in the velocity at the instant of impact the greater the ramming effect, and by the laws of impact the heavier the anvil the better. Efficiency in a plain jarring machine naturally increases with the weight put into the anvil; but since the cost of the machine depends very largely upon the weight of cast iron or concrete used, the weight of the anvil is generally limited to that of the loaded table. When the anvil is bedded on rock, it becomes practically of infinite weight, and capable of developing the maximum ramming effect for any drop given to the table. A rock bottom does not, however, eliminate the destructive ground waves, and often facilitates their transmission to unusual distances. To mitigate the effect of these shocks the practice has been to bed the anvil on a timber cribbing, after the manner employed for steam hammers.

An anvil cushioned upon a wooden crib may be considered as a floating anvil, in which the supporting medium is very dense and highly resistant, but in which also the resistance to compression is trifling compared to that of rock. The stiffness of such an elastic bedding for an anvil might be estimated from the anvil movement, of which no data are at present available; but, however effective it may be in the initial stages of the jarring process, it can have but little, if any, effect upon the final stages after the sand has been rammed to a density in excess of that

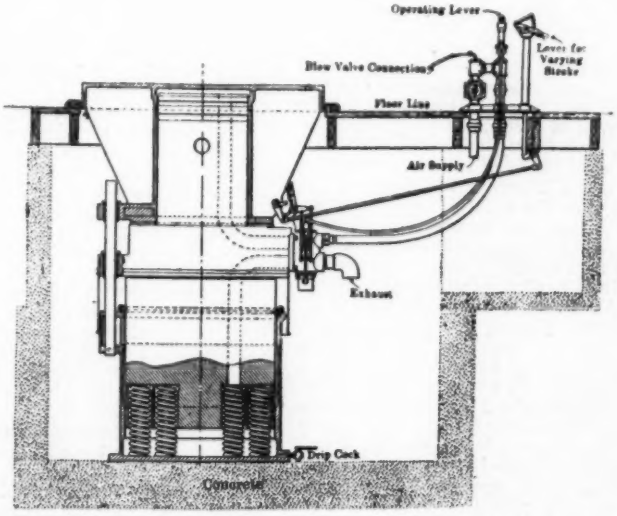


FIG. 3.—SECTION OF JARRING MACHINE TO HANDLE MOULDS WEIGHING 25 TONS.

corresponding to such elastic resistance. It may be said without hesitation, therefore, that anvils cushioned upon wooden cribbing are much less effective than anvils founded in rock, and that such anvils, equal in weight to the loaded table, have in the final stages of the jarring process a comparative efficiency of only 25 per cent.

Description of the Machine.

The shockless jarring machine consists, in its usual form, of a jarring table mounted upon an upstanding plunger forming the anvil, which in turn is mounted in a cylinder base and supported upon long helical steel springs. Compressed air, as the working fluid, is admitted through an automatic valve, under hand control, attached to the plunger or anvil base, and passes first into the jarring cylinder to raise the loaded table. At some predetermined point in the table movement, the air is automatically cut off from the cylinder, and while the valve is reversing, the confined air will expand and lift the table further from its anvil, provided its initial pressure exceeds the balancing pressure due to the weight carried. Then, when the operating valve completes its reverse movement the air from the jarring cylinder may be exhausted into the atmosphere, but preferably it passes from the jarring cylinder to the anvil cylinder beneath, and the table drops by gravity against the reduced pressure in its cylinder. At the same time, the plunger base or anvil is relieved of a considerable part of the load carried by its supporting springs, which immediately expand, giving the anvil an upward velocity to meet the falling table. When air is expended from the jarring cylinder into the anvil cylinder this upward velocity of the anvil is augmented and the falling velocity of the table is somewhat retarded, but in any case the momentum of the rising anvil is substantially equal to that of the falling table at the instant of impact. As a result, both table and anvil come to rest with great jarring or ramming effect upon the sand, but without shock or jar upon the foundation or any surrounding material.

When the air from the jarring cylinder is discharged at once into the atmosphere the momentum of the falling table may somewhat exceed that of the rising anvil at the instant of impact; but when this air is expanded into the anvil cylinder it compensates more or less for the loss of spring pressure as the anvil rises, and in this case the momentum of the rising anvil may exceed that of the falling table at the instant of impact. The difference, however, need not be very pronounced, and simply results in a slight initial velocity of the table and anvil at the beginning of the next stroke.

The advantage of the second expansion is twofold; it utilises the potential energy of the compressed air in augmenting the momentum of the anvil, and at the same time it checks the acceleration of the table due to gravity and holds it in contact with the load upon it while falling. Otherwise a poorly fitted pattern board or flask may tend to spring away from its support while falling and cause lost motion, productive of a bad mould. For the same purpose, when the air is discharged directly from the jarring cylinder a long compression spring between jarring cylinder and its plunger may be introduced with good effect. In several instances such springs as shown in Fig. 2 have been made to carry half the weight of the table with 8-in. compression. They assist in lifting the loaded table, and retard its acceleration in falling; and by their use the lifting capacity of jarring tables may be considerably augmented. Their chief purpose, however, is to retard the falling table and hold the pattern flask and sand firmly against it in readiness for the coming blow. With such a spring, the action of the table is, of course, somewhat slower in falling and more stroke is required to produce a given velocity of impact. On the other hand, the table rises faster and runs further to produce a given blow, and the increased stroke reduces the percentage of clearance space to plunger displacement. The spring in this position has, therefore, some beneficial effect upon the consumption of power, while serving a much better purpose, in the production of good moulds, and although not so important when the air from the jarring cylinder passes through the anvil cylinder, it may be of some value in that case also.

The valve mechanism, and the means by which it is controlled, do not particularly concern the present discussion. It will suffice to say that the machine is started and stopped by an operating lever which controls the admission of air to the automatic mechanism. So long as this lever is held down, the machine will run automatically, and when released, the machine will stop. A latched lever is arranged to adjust the stroke, which can be varied while the machine is running. A safety stop is also provided to limit the table movement through the action of the main valve attached to the plunger base. When pressure is admitted to the jarring cylinder, the anvil cylinder opens to exhaust. When in action, it descends while the table is rising and then rises to meet the falling table.

Fig. 1 represents the design of a machine now being built for a large foundry to handle half-moulds weighing 25 tons. The table is a steel casting 8 ft. by 12 ft., with lifting cylinder 3 ft. in diameter, and the plunger base forming the anvil is a solid iron casting weighing 65,000 lbs. This is carried upon 22 steel springs, designed to compress 8 in. under the maximum load and to develop a working stress of only 60,000 lbs. per square inch, which is very much less than the usual working stresses on railway car springs and quite within safe limits. The total weight of the machine complete will probably be in excess of 90,000 lbs. This is carried in a concrete pit designed simply to protect the machine and to support the static load on the floor of the pit.

A floating anvil which does not rise to meet the falling table, when equal in weight to the latter, has only one-quarter the efficiency of an anvil founded on rock. The efficiency of such an anvil, when mounted and actuated so as to acquire a momentum equal to that of the falling table at the instant of impact, remains to be determined. Obviously, the anvil will meet the table midway when the latter has fallen half the distance by which they were separated. In terms of the velocity of the table falling the whole distance, its velocity at this point will be $\sqrt{\frac{1}{2}}$, and the velocity of the anvil will be the same. But in this case the velocity of the table is entirely destroyed, while in the previous assumption the change in velocity at the instant of impact was only half the final velocity. The relative changes in velocity are, therefore, as $\sqrt{\frac{1}{2}}$ to $\frac{1}{2}$, and the ramming effects in the two cases will be to each other as the square of $\sqrt{\frac{1}{2}}$ to the square of $\frac{1}{2}$, or as $\frac{1}{2}$ to $\frac{1}{4}$. Under the assumed conditions the anvil in the shockless machine is therefore twice as efficient as the same anvil cushioned on a wooden crib.

Attention should also be called to the possibility of installing a machine of the shockless type on the upper floors of high buildings, where many foundries are now being located. The action of the machine is entirely free from jar except where it is wanted, on the work produced, and the pulsating variation in floor load while running is no greater than is usually experienced in the operation of power squeezers.

Why Brass Castings Often Fail.

By A. Napier.

It has often been said and on very good grounds, that brass castings cannot be produced successfully to scientific line and rule, but can only be turned out by the founder who has that intimate knowledge of the metals that comes from long experience and practice. Certain it is that bell castings, for instance, have never yet been successfully produced on the principle of observing set scientific rules and formulæ; very many times this has been attempted, but the man who succeeds is he who knows his metal by its appearance, and who applies, not the instructions of the scientists and the chemist, but the almost instinctive knowledge that characterises the true craftsman of experience.

But why is it that work based on scientific facts, and taking into regard what appear to be all the essentials concerned, so often fails hopelessly in actual practice? Theoretically this should not be so, but too often it is. It would appear that, however well the procedure may be arranged, it is almost impossible to so determine and control certain features that occur in practice as to obviate the necessity for the rule-of-thumb skill of the practical man. This is probably the case to a greater extent with non-ferrous work than with iron, for many of the brass and bronze founder's metals are particularly susceptible to slight changes in conditions. Given definite quantities of the constituent metals of a certain brass, a furnace in which they may be melted at accurately determined and regulated temperatures, the entire exclusion of air (and consequently oxygen) and any undesirable elements likely to cause trouble or changes, and given also conditions of pouring that did not allow of material oxidation, and castings of definite composition, strength, and purity might reasonably be expected. But in the best regulated of foundries these conditions can scarcely be said to rule. In the first place, only in exceptional cases are definite quantities of pure metals alone used (apart, of course, from high-class art metal work); some scrap is generally employed, and this scrap is to some extent of unknown quality. The loss of zinc in melting, also, will vary very considerably according to the furnace conditions, for the heat of the foundryman's furnace is not ascertained and regulated to a nicety, and thus a further variable is introduced. The introduction of air into the furnace is another feature that is greatly influential, for the contact of the oxygen with the molten metals will cause oxidation of these that will quite upset the calculations of the foundryman. Under the circumstances, then, he is dealing with a collection of uncertainties that may be approximately regulated and controlled, if his skill and knowledge are equal to it; but the scientific accuracy that is the dream of the theorist, is too elusive to be hoped for in ordinary foundry practice. Having acceded that much, and having acknowledged the difficulty of dispensing with the rule-of-thumb skill of the experienced man, it may be as well to consider some of the directions in which the foundryman unnecessarily neglects the assistance which science offers, and to consider, also, some of the essentials for good work.

The Furnace.—According to the class of furnace employed for brass melting, there may be one or more of several conditions operating to produce bad metal, or metal of uncertain composition. Take first the coke-fired crucible furnace. It is believed by many foundrymen that any coke which will ultimately give the necessary heat for melting, and sufficient charcoal to cover the metal in the pot, will secure a melt as free from oxidation as can reasonably be expected; but this is not the case. It might be so were the metals covered with the charcoal the whole of the time, and kept from contact with the sulphur and other fumes from the coke, and kept, also, from the oxygen being drawn in to support the combustion of the fuel. But in foundry practice the metal in the crucible—lumps of scrap, ingots, etc.—are in contact with the air and the furnace gases right up to the point of melting and falling as molten metal into the body of the crucible and under the protective charcoal. Accordingly, a coke which is over-long in reducing the metal to a molten condition allows the metal so much longer opportunity to suffer, while a coke high in sulphur —gas coke, for instance, instead of a good foundry coke—introduces a greater amount of objectionable sulphur fumes. The best furnace is that which gives the requisite heat to melt the metal while allowing the least opportunity for the metal to suffer.

With the oil-fired furnace, too, deleterious conditions often prevail owing to the bad adjustment of the air supply to the fuel supply, causing an oxidising flame to come into contact with the metal instead of a reducing flame. The ideal conditions under which oil is burned for such purposes are those which allow of just sufficient air supply to properly support the combustion of the oil, without allowing any excess of air (and consequently oxygen) to enter the furnace; but as these precise conditions are extremely difficult to obtain, it is far better to waste a little fuel and produce a rather smoky but reducing flame, than to allow an excess of air to enter. The maximum of heat is, of course, not thus obtained from the fuel, but the metal will be safer and the waste of heat will be only trifling. In a gas-fired furnace the same principle of considering the effect on the metal in preference to the maximum heat efficiency of the fuel, should be regarded.

Particularly in the class of furnace which allows the flame to play in direct contact with the metals are these considerations of importance, and as such furnaces are generally used where large quantities of metal have to be melted, the matter is of extra consequence on account of the amount of metal that will be damaged at one time by bad melting conditions.

Having secured the best possible conditions as regards fuel and heat, it is next necessary to turn attention to the question of protecting and cleaning the metal by fluxes or protective coverings—fluxes as distinct from deoxidising additions which may be deemed necessary to finally cleanse the molten metal.

Fluxes.—Taking the term "flux" in its strict sense—*i.e.*, as implying non-metallic substances, such as borax, fluor-spar, *etc.*—it is surprising what differences of opinion exist in different foundries as regards the relative virtues of the different materials employed. Even though some deoxidiser is introduced just prior to pouring the metal, it is generally advisable to use some protective covering or flux to ensure the metal melting with the least possible loss and oxidation. But according to the nature of the materials being melted, so are various fluxes more or

less suitable. There are fluxes which have an excellent effect on the metal itself, but which attack the crucible so strongly as to render their use out of question from the point of economy in crucibles. This liability of the crucible to suffer, however, cannot always be given first consideration, and it is often advisable, for example, to use fluor-spar, despite the fact that it attacks the clay that is mixed with the plumbago in the crucible. When clean, good scrap and ingot metal are being melted, a covering of charcoal to prevent contact of the molten metal with the atmosphere is generally sufficient, but when dirty scrap, turnings, etc., are put into the pot a flux of some sort to dissolve the oxides and clear the dirt from the metal is practically a necessity. It is necessary, when employing a flux, to determine first what duty it has to fulfil. It is as foolish to think that the same is suitable for all purposes and conditions as that all metals will melt with the same facility and cleanliness as will good scrap and ingot. Where there is much in the nature of impurities to remove it is useless, for example, to employ as a flux the once popular powdered glass, as this, though it melts and forms a good protective covering, does not touch the impurities in the metal. If siliceous materials are present, too, as in the case of washings and grindings, borax is not good enough; it will dissolve the metallic oxides, but has no effect on siliceous matter. Fluor-spar, on the other hand, will dissolve both the metallic oxides and any siliceous materials present, and if these are present in any considerable quantities, the flux will not attack the crucible to a great extent, while if about one-third of lime be added to the fluor-spar the slag will be easy to skim off. The tendency of plaster of Paris to give off sulphur fumes when in contact with coal or coke, is regarded by some as an objection to its use, but it is a very efficient and popular flux, as also is common salt. It is not the writer's intention, however, to discuss the relative virtues of different fluxes. Sufficient to say the conditions of the metal to be melted must govern the choice of the flux, the object being to get the metal as clean and free from dirt and dross as possible. The point is that the use of an ineffective material to protect or flux the metal is frequently the cause of dirty castings.

Pouring.—A fact often overlooked in the foundry is that even though full precautions have been taken in selecting and melting the metal, a little carelessness in pouring may render all previous care useless. While it is important not to overheat the metal, it must be sufficiently hot to burn the film of zinc oxide that forms on the surface. As far as possible, too, contact with the atmosphere should be avoided, or the metal will oxidise and carry dirt and dross into the mould. This dirt is very liable to collect in corners of the mould, and give weak places which fail either under test or in use.

Design.—While the neglect of one or more of the precautions outlined in the foregoing notes often is the cause of faulty castings, many defects are really inherent in the design; so much so that it is a practical impossibility to mould and pour some designs so as to get good, sound castings. The shrinkage of brass during solidification and cooling is a matter which is often overlooked in designing, as also is the question of crystallisation. The placing of very thin parts in connection with heavy parts cannot always be avoided, but where possible the junction should be so modified as to prevent the unequal shrinkage causing a rupture or strain. Sharp corners and angles, too, are not often necessary, though they appear in many designs and if not modified by filleting, and so forth, in the pattern shop tend to give places with weak crystallisation and shrinkage strains. No matter how tough and good a mixture of metal may be, such designs will always be accompanied by weakness.

Gating and Risers.—Among the most prolific causes of defects must be included bad gating and the absence or insufficiency of risers. It is no uncommon thing to see flat castings poured with only a comparatively small gate and no riser, and while such castings may never prove faulty if not machined or subjected to any special stress, should machining be done or strain applied defects will almost inevitably appear. The reason is that the defects are not surface ones, but occur internally, as the result of uneven cooling. In the absence of a riser or a feeding head large enough to keep molten until all the casting has solidified, the outer portions will cool first, and the casting in shrinking will draw from the centre while it is still molten, leaving a shrinkage cavity. This is aggravated by the cool mould quickening the solidification of the outside of the casting, while the gate, if not large enough to keep fluid and act as a feeding head, will not supply the necessary extra metal to make up for the shrinkage and give a solid casting. As the gate cannot always be constructed so as to properly feed the mould during cooling, it is better in such cases to add a riser or feeding head of large size. The extra trouble involved in trimming this off is a very small consideration, particularly in view of the good effect produced. The position of the riser will depend on the shape of the casting, but it must be so placed as to supply the metal to the thickest part, which will be the last to solidify, and from which the metal will be drawn by the shrinkage. The same principle must be applied to work of other than flat shape, for in most cases where the design is at all intricate, there are parts which will be slow in cooling and thus be liable to shrinkage defects. It is advisable also, especially with work that has to stand pressure, as in the case of valve castings, to place risers in positions to deal with any dirt that possibly may enter the mould, so that this may not be trapped in awkward places and cause weak spots.

The foregoing brief review of the conditions to be observed in order to secure clean and sound castings, and of some causes of failure, by no means covers the ground, but it may assist some of those who are incurring trouble through neglect of what are often simple precautions.

PROGRAMME OF IRON AND STEEL INSTITUTE, BUXTON MEETING.—Mr. G. C. Lloyd, Secretary, has issued the preliminary programme of the autumn meeting of the Iron and Steel Institute, to be held at Buxton, on Monday, Tuesday, Wednesday, Thursday, and Friday, September 26-30, next. The programme includes, in addition to the Papers to be read and discussed, a visit to the works of the Midland Railway Company at Derby, a visit to the Royal Crown Derby Porcelain Works, an excursion to Chesterfield, where the members will be invited to luncheon by the Staveley Coal and Iron Company, and visit the Company's works, a visit to the Broad Oaks Iron Works, an excursion by invitation of the London and North-Western Railway Company, to the Crewe Works, the party being entertained to luncheon by the directors of the Company at the Crewe Arms Hotel. On Friday His Grace the Duke of Devonshire will invite the members and their ladies to a garden party at Chatsworth.

Foundrymen's Visit to Daimler's Motor Works.

One of the best appreciated visits by the Birmingham Branch of the British Foundrymen's Association took place on Saturday, June 4, when between 50 and 60 members journeyed to Coventry to visit the works of the Daimler Motor Company, Limited. The party, on arrival at the works, were met by Mr. Andrew Harley, the foundry manager, who, with the help of Mr. A. Wardle, assistant manager, conducted the visitors round the various shops.

The Daimler Works present one of the most striking examples of up-to-date British enterprise, and of the resolute determination of industrial experts to secure their share of a rapidly-growing industry. The formation of the Company dates back only to 1904, yet so extensive is the establishment that the two estates, at Coventry and Radford, on which the works are built, comprise 35 acres, of which the shop constructions already erected cover 14 acres. Most of the shops are on the Coventry site. The only buildings at present on the Radford estate are the erecting shop and the foundry. The building is at present in two sections, which are being connected. When completed, the length will be 1,340 ft. and the width 180 ft. The main supports consist of iron stanchions, intersected by girders, with a concrete base. The total number of men employed by the Company is nearly 4,000. At least 14 different trades are employed in connection with motor-car manufacture, namely, machining, fitting, engine testing, erecting, car testing, coach-making, painting, trimming, finishing, smithying, copper-smithying, electro-plating, pattern-making and moulding, and in the whole of these trades machinery has been employed to the fullest possible extent. The lighting is mainly by electricity, high and low-pressure incandescent gas being also employed. The shops are heated partly by the Plenum system and partly by direct steam heating. The buildings are protected against fire by a complete installation of sprinklers.

The first shop visited was that known as the running shop, to which cars about to be tested on the road are sent. In the engine testing shop a very interesting piece of mechanism was the engine of an aeroplane. It was in this shop that the preliminary and final stages of some remarkable tests, conducted under the inspection of judges representing the Royal Automobile Club, were carried out.

The machine shop is laid out on quite exceptional lines, being of a four-storey type, with a clear opening at the centre from the roof, so that the whole of what may be called the decks are on view from the floor. They are well equipped with tools and appliances. In this shop there are about 100 electric motors. Many of the machines are of the turret and capstan lathe type, and there is a splendid installation of automatic and semi-automatic machines by Alfred Herbert, Limited, of Coventry. Most of the power required is generated by two Diesel oil engines, each of 350-b.h.p. The Diesel system is found to work perfectly, and reduces friction to a minimum, while securing perfect combustion of the oil. The engines are run on the four-stroke system, and the generating cost for four months proved to be 0·4023d. per kilowatt hour per unit. The ignition may be described as in a sense spontaneous, inasmuch as the oil when attaining a temperature of 1,000 degrees ignites.

FIG. 1.—FOUNDRY AT THE DAIMLER WORKS; BAY WHERE CAST-IRON CYLINDER HEADS ARE MOULDED AND CAST.

Naturally, the greatest attention of the visiting party was devoted to the foundry, which constitutes an extremely important department of the establishment, and finds employment for about 200 men and boys in the production of castings in iron, malleable iron, steel, various alloys of gun-metal, brass, and aluminium. A strong feature of the foundry is its chemical laboratory, in which all classes of raw material are tested on arrival; metals are mixed with strict regard to their content and character, and

full records of analyses are kept for immediate reference. This is necessary, as all the castings have to meet very strict specifications; and, as most of them have also to be machined, the slightest flaw would involve rejection.

The melting plant consists of two cupolas for melting cast iron, one battery of 15 crucible furnaces for malleable iron and steel, and one battery of six crucible furnaces, one Charlier, and one M.R.V. furnace for gun-metal and aluminium. The latter are contained in a special furnace-room, which is exhausted by two powerful fans. The men chiefly concerned in melting brass are supplied with respirators of special design, which absolutely prevent inhalation of any fumes.

The annealing plant consists of three stoves built by Gibbons Bros., of Dudley, each of which has a capacity of about 5 tons. They are heated by gas producers, and the temperature is recorded by a pyrometer. For all kinds of repetition work the fullest use has been made of the moulding machine. The appliances in operation include one jarring machine for malleable castings; two London Emery Works Company's machines employed in the cast-iron section; three Bonvillain machines, used chiefly for brass and aluminium castings; and five hand-press machines, supplied by the Britannia Foundry Company, of Coventry. Of the latter, three are used entirely for moulding the cast-iron sleeves used in the new "Silent Knight" engine. There are also three moulding machines, designed by the Company's own experts, for special castings. The conditions of motor production are very favourable for repetition work, and the use of machinery has enabled considerable economy to be effected.

All the cores required are made in one section, while for the most important castings metal boxes are used. There are four core-making machines, and for drying moulds and cores there are two pairs of gas-heated core stoves, built by Messrs. R. & G. Hislop, of Paisley, which are placed on either side of the cupola-melting plant. A system is employed of setting the cores mechanically, and of gauging every mould previous to casting, with a view to securing absolute accuracy. Much importance is attached to this part of the work, for which a special staff of inspectors is employed. The fettling shop is equipped with up-to-date plant for grinding, a band-saw for cutting steel gates, one for cutting aluminium gates, and a cutter for brass castings. The fullest use is made of compressed air, which is laid on all over the shop, and is employed chiefly for moulding machine vibrators, dusters, jarring moulding machines, pneumatic hammers, and pneumatic hoists. A considerable variety of parts is turned out of the shop, such as cylinders, cylinder heads, sleeves, pistons, and piston rings, while a large variety of gun-metal alloy and high-quality aluminium castings are also produced.

The visit concluded with an explanation of the system of testing and the recording of analyses, and much admiration was expressed of the quality of the malleable iron, a sample of which had been bent double under pressure, without showing the slightest sign of fracture or injury. A large staff of chemists is employed in the chemical laboratory.

FIG. 2.—FOUNDRY AT THE DAIMLER WORKS; BAY IN WHICH CAST-IRON SLEEVES ARE MOULDED AND CAST, SHOWING HISLOP CORE OVENS.

Before leaving the works, Mr. R. Mason (Branch President) moved a hearty vote of thanks to the Daimler Company for their kindness in allowing the visit, and especially to Mr. Percy Martin, the managing director, also paying a tribute to Mr. Harley and Mr. Wardle for their personal attention and instructive explanations. Mr. Mason remarked that no restriction had been imposed, the visitors having been given the fullest opportunity of seeing everything. They had been greatly struck by the simple methods employed in the production of the most complicated work. The possibility of arranging such a visit further exemplified the advantage of belonging to the British Foundrymen's Association, since such privileges could not have been obtainable by individual members.

The vote was seconded by MR. R. BUCHANAN, who said he had personally been impressed with the great accuracy which marked the carrying out of all the practical work of the establishment. The best testi-

monial to that accuracy was the splendid position the Daimler Company had secured in the motor world. He regarded it as a great privilege to have

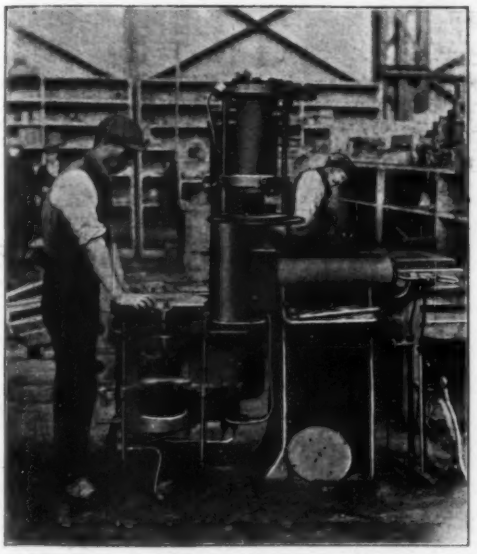


FIG. 3.—A BONVILLAIN MOULDING MACHINE AT THE DAIMLER WORKS.

been brought into personal contact with a firm of such a go-ahead character.

The vote was carried with great heartiness.

MR. A. HARLEY, in acknowledging the compliment,

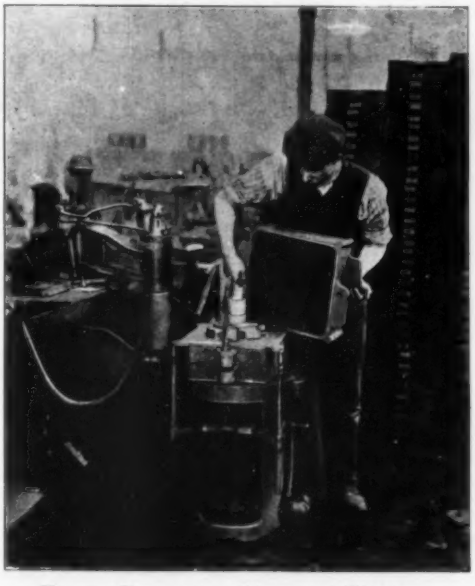


FIG. 4.—BONVILLAIN MOULDING MACHINE, SHOWING MOULDING OF A MALLEABLE CAST-IRON DIFFERENTIAL BOX

said that the visit had been a sincere pleasure to himself, and the Company were equally pleased to exhibit their works. They made a point of openly explaining their operations, and were not actuated by that spirit of secrecy which some firms appeared to maintain in regard to their methods. As was seen by the visitors, great extensions were in progress, and perhaps at some future time the Association would consider it worth while to pay another visit.

FIG. 5.—PNEUMATIC JARRING MACHINE FOR MALLEABLE IRON CASTINGS.

MAKING OF MODERN GRINDING-WHEELS.—Grinding-wheels are now more freely manufactured from carborundum. Originally on account of its high price this material was only used for special purposes, but more economical and systematic methods of manufacturing of carborundum have rendered its use more general in machine shops. The materials from which it is formed, coke and sand high in silica, are mixed together in proper proportions with the addition of a little salt and sawdust, and are placed in the electric furnace which is in the form of a trough about 30 ft. long by 7 ft. wide, and are packed round a core of granulated coke acting as a conductor and extending between the electrodes. The furnace is then bricked over and the current turned on at a pressure of about 250 volts, which is reduced to about 185 volts as the resistance decreases. The operation takes about 36 hours, and requires 2,000 h.p. Although the temperature is about 7,000 degrees Fahr. the brickwork does not suffer, owing to the bad conducting properties of the mixture. The carborundum crystals are crushed by manganese-steel rolls. The crushed material passes through a magnetic separator to remove the steel abraded from the rolls. It is then graded in the usual way by sieves of varying mesh. For very fine qualities water is used as the separator. The wheels are made of the ground carborundum held together by binds, such as kaolin, for harder wheels, and shellac for softer grades. Every wheel is tested to double its normal speed in a protected chamber.

Artificial Moulding Sands.

By Walter J. May.

Moulding sands are derived from various sources in this country, and may be yellow like the Erith and Charlton sands, or red like the Mansfield or Birmingham "Cemetery" sands. The colour in itself, however, is no guide as to the quality of the sand. In fact, taking the Hammersmith or Bedford yellow building sands or the red sands devoid of aluminous or other agglutinating matter, it would puzzle a good many people to make a coherent mould with such material. In the Cheylesmore sand pits, Coventry, there is a capital fine sand free from agglutinating matter, which is overlaid with a very sticky, loamy sand, which has too much agglutinant. Ten or eleven years ago the moulding sand was brought from a distance, the local sand being ignored. The writer wanted sand at the time, and to save expense examined the local stuff, eventually using it with success in the following manner. Two loads of sharp sand and one load of "marl" or top sand were secured—there is no marl at all in the pits—and after being well mixed with shovels the sands were thrown in a heap and well trodden down. In a fortnight the heap was chopped down and passed through a ¼-in. square meshed sieve, and was then used as needed for iron, brass, or gunmetal. For the former it was made up as a facing sand with coal, the moulds being backed with old floor sand, while for brass and other yellow alloys it was used alone. For all purposes it answered well, and the cost of the sand came to just 4s. 10d. per load of about 25 cwts. when ready for use, as against about 10s. per load for imported sand in small lots.

Moulding sand requires silica to provide the necessary refractory material and some binding material to act as an agglutinant to hold the grains of silica together without destroying the porosity of the mass. Aluminous matter is probably the cheapest and most readily obtainable for this purpose, about 10 per cent. to 12 per cent. being usually sufficient for the purpose, but necessarily the actual percentage would be somewhat variable. This, of course, applies to the making up of sands from local materials, which are readily available, but which have to be prepared artificially. Care must be taken that substances which might disadvantageously affect the metals cast are not present, as in some places substances not desirable in a sand for moulding purposes do occur. For instance, one would not care to use sand holding copper deposited from the water from a copper mine, nor from a place where the waste from a cyanide gold-concentration plant was deposited, while sand containing pyrites, lime, and other undesirable substances should certainly be avoided. These remarks do not apply to moulding sands found ready for use, but to such sands as have to be manipulated to bring them into a usable condition.

Sands which are water-worn and consist practically of round grains are probably the most porous, but they also require a larger proportion of agglutinating material to make them workable than do those which are composed of irregularly shaped grains, and in the end they are probably more difficult to deal with and less porous.

In making up sands with natural products it is desirable to allow time enough in the work to permit of the proper mingling of the materials used. Taking, say, a clean non-binding sand, with clay to act as a binder, roughly the following method should be adopted. The clay should be reduced with water to a thin, creamy slurry; then the sand should be arranged somewhat like a basin, and while the slurry is poured on gradually, worked up into a mortar-like mass with the clay distributed as equally through the mass as can be managed. It should then be thrown into a close heap and allowed to remain for perhaps a month, after which it should be broken down, again mixed into a mortar-like mass with water, and thrown into a heap again. At the end of another month it should be broken down and passed through a ¼-in. square meshed sieve, when it will generally be fit for use if the right proportions of sand and agglutinant have been used. These proportions vary somewhat according to the quality of the materials used, no strict proportions being applicable, although as a rough guide, from 8 per cent. to 15 per cent. of aluminous matter may be taken to cover the ground. Apart from the more natural products for moulding sand are such materials as crushed siliceous stone mixed with pipe-clay or china-clay. These and other somewhat similar combinations may be employed where sands and natural clays do not exist, but these mixtures need a little thinking out. For instance a crushed sandstone properly graded provides the siliceous base of the sand very well, but unless some binder is used it will not stand as a mould. If clay of a more or less tenacious nature, or even river mud free from obnoxious materials can be obtained, the matter becomes an easy one. But if clay or similar material cannot be had, then recourse must be had to some other substance, starch, flour paste, or the like, using sufficient to enable the mould to be made. Some care is necessary to get the right proportions of these materials, actual experiment being necessary to determine them. If sand would hold together in a mould without a binding agent it would remove a good many casting difficulties, the porosity of the material then being unobstructed, but such a thing is, of course, impossible.

For very fine work, such as replicas of medals, very fine facing sand is a necessity. Probably as good a facing sand as could be produced would be ground Bath brick sifted through a 60- or 70-mesh screen, the fine stuff thus produced being mixed with about 20 per cent. of china-clay and then air-dried, the mass being pulverised and again sifted, the necessary damping for moulding purposes being done as the facing is needed. Such a sand carefully dusted with plumbago and sleeked down with a soft brush, would, when dealt with by an expert moulder, produce surfaces as smooth as those obtained in stamping, but the cost would be heavy owing to the tedious nature of the work. A dough of plumbago and china-clay would be less trouble to use, but it would not be a sand, while more skill would be needed in getting castings.

Carborundum is being used for some kinds of casting, and seems to offer considerable advantages in some cases, though it is rather open to question

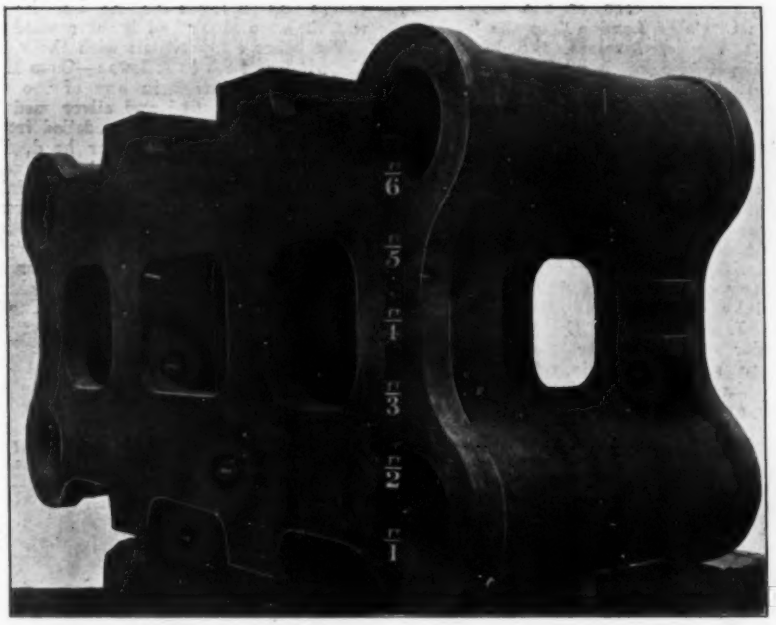
whether as good results are not obtainable with a carefully graded natural sand treated in the same way as the carborundum. The heat which the moulds have to stand against in actual foundry practice is not excessive except where steel is concerned, and in most cases moulds composed chiefly of siliceous materials are sufficiently refractory.

Where only moderately refractory materials are used in preparing moulding sands artificially, to prevent them burning into the metal it is necessary to use a facing sand containing carbonaceous material, coal usually being adopted for iron, and pea or bean meal for brass and the like. These supply a thin layer of gas between the mould surface and the metal, but if this is not found to be sufficient protection, sleeking the face of the mould with properly ground plumbago is usually sufficient to provide a clean skin to the castings. Heavy, or rather, thick castings which retain their heat for some considerable time, are more likely to have the sand fused into the surface than light ones, this point having to be taken into consideration when pouring, but as a rule the plumbago will stand against any heat used in the ordinary foundry. A wash composed of roughly 80 per cent. plumbago and 20 per cent. china-clay applied to the surface of a mould and dried on, will prevent any chance of sand burning into the skin of the castings. Ordinary blacking has not the same effect where it is used in place of plumbago.

A Large Casting for Italy.

A 4,500-ton hydraulic forging press has recently been completed and despatched by Messrs. Davy Brothers, Limited, of the Park Iron Works, Sheffield, to the order of the Societa degli Alti Forni, Fonderie ed Acciaierie di Terni, of Italy. The cast-steel baseplate of this press was manufactured by Messrs. Cammell Laird and Company, Limited, Sheffield, and its overall dimensions are—16 ft. 3 in. in length, 8 ft. 1 in. in width, and 6 ft. in depth. The weight is 56½ tons.

Some idea of the design and dimensions of this casting will be gathered from the accompanying illustration. Owing to its abnormal size and exceptional weight, elaborate arrangements had to be made for the transport of the casting to the shipping point on the Mersey. For the haulage from the Cyclops Steel and Iron Works to the Midland Railway Company's loading dock three powerful traction engines had to be requisitioned, although on a portion of the route two engines only were necessary. The transport to Liverpool was carried out by the Midland Railway Company's staff, and necessitated the temporary suspension of the ordinary Sunday traffic. The largest piece, comprising the anvil block, required the use of two 40-ton armour-plate wagons connected by means of a stretcher and fitted with long oak baulks. These baulks were used in order to distribute the weight evenly over both wagons, and they were passed through an opening in the casting. The cross girder was carried upon a Midland Railway trolley wagon fitted for the purpose.



A Large Casting for the Terni Works.

The smaller portions of this hydraulic forging press were loaded on to the Cunard steamship "Lycia" by means of the shipping Company's own appliances, but after arrival at the Midland Railway Company's Alexandra Station at Liverpool the wagons carrying the heavier castings were hauled by the Mersey Dock Board engine to the 100-ton crane at the Langton Dock, and there shipment was effected. It is stated that these castings are the largest ever taken from the Mersey to the Mediterranean, and remarkable arrangements are being made at Spezzia for their removal from the hold of the "Lycia." Spezzia, the principal naval port of Italy, is 160 miles distant from Terni, and the problem of conveyance of this load over such a long route will establish a new record in Italian State railway organisation.

An Exhibition of Castings and Models.

On Tuesday and Wednesday, June 7 and 8 last, the Worshipful Company of Founders held an exhibition of castings and models in metal and designs, in competition for prizes, medals and certificates given by the Company. The exhibition was held at Ironmongers' Hall, London, E.C., which was lent for the occasion by the Ironmongers Company, and was the fourth of its kind held by the Founders Company, the object being to encourage and assist skill in the trade of founding.

The Worshipful Company of Founders, it is interesting to note, was in existence as a "Misterie" or "Guild" as far back as 1276 A.D. So jealous was the Guild, even in those days, of the way founding work was done, that in 1365 A.D. a petition was presented by "the good men of the Misterie of ffounders of the Cittie of London" to the "Honorable and Right Worthy Masters, the Maior and Aldermen of the Cittie of London," complaining "that articles of false metal and false solder were being made so that Candlesticks, Buckles, Straps and other such like articles when exposed to fire or great strain cracked, broke and dissolved to the peril and damage of those who purchased them and to the great slander of the City and the whole Mistery," and praying for "ordinances" to be allowed regulating the manufacture of such articles and the conduct of the members of the mistery. On October 13, 1590, a Grant of Arms was made to the "Company of the Art and Mistery of the Founders," and by Royal Charter dated September 18, 12 James I. (1614), the Company was Incorporated under the corporate name of "The Master, Wardens and Cominaltie of the Misterie of ffounders of the Cittie of London," and thereby the Guild were authorised to make search for and seize all articles not properly manufactured and to stamp all weights and measures and destroy those that were not of "proper size." The Founders Company are legally entitled to stamp all weights and measures, and they yearly appoint "two Sizers" and "two Searchers" under the provisions of their Charter. A second Charter, dated February 28, 1 James II., was annulled by 2 W. & M., c. 8, s. 14, and the Charter of 1614 is the only one in force affecting the Founders Company. From time to time various "ordinances" or "articles" were agreed to by the Court of Common Council with reference to the management of the Guild, the conduct of its members, and dealing also with the apprentices.

The Court of the Founders Company in order to encourage "Apprenticeships," yearly offer sums of money to former apprentices on completion of their service under Articles to Liverymen of the Company. Previous exhibitions were held in 1880, 1898, and 1900.

At a meeting of the Court held in October, 1909, it was resolved that the Master Wardens and Court of Assistants of the Company do hold an exhibition of castings and models in metals, viz., aluminium, bronze, brass, gold, iron, and silver, all to be cast from the crucible, also of designs in wood, plaster, or any suitable material for casting from, and they would offer prizes to be competed for by founders, designers, craftsmen, apprentices and improvers, British born, engaged in foundry business or allied trades, and residing in England. The examples of metal work were to be either finished castings or as they leave the mould with seams showing, and such works to be illustrative of art, architectural, mechanical, commercial and other uses.

The first section of the competitions, the results of which were shown last month, offered a first prize of £20 and a second prize of £5 for the best model of a medal for the Founders Company, the obverse to bear the coat of arms of the Company. The first prize was won by Mr. A. Stanley Young, whose design on the reverse of the medal depicted the pouring of a mould from a large ladle. The second prize was awarded to Miss Agnes Keshaw Halliday. An effort which attracted some attention was by Mr. H. C. Eyres, the designer having endeavoured to embody in his design some of the better known and still extant works of the founders' craft. This design was an ingenious one, but the general opinion was that too much had been crowded into the space.

The other competitions with the names of some of the winners were as follows:—Class I.:—(A) For the best casting (except in any of the undermentioned subjects), First, £15 and silver medal, won by Mr. A. Huskinson, for a goat modelled from life. (B) For the best group or figure or head, First, £15 and silver medal. (C) For the best panel in ornament or figure, First, £15 and silver medal, won by Mr. H. E. Warren, for an ornamental panel for a grate-back. (D) For the best bell (not to exceed 9 in. in diameter), First, £5 and certificate (given by Sydney R. Pollard, Esq., the Master), won by Mr. A. F. Sysachman, for the model of a church bell, loam cast. A brass bell representing "The Resurrection," by Mr. J. A. Jackson, secured the second prize, and a special prize was awarded to Mr. J. Hanks for an ornamental bell. (E) For the best design for cast railing, Prize, £5 and certificate (given by the Worshipful Company of Ironmongers). (F) For the best design which might be a drawing, model, or pattern for any kind of cast metal work. In the second class, for apprentices and improvers, some of the successful exhibits were as follows:—(A) "Lion and snake," by Mr. G. H. Ellis, 1st prize; "Tiger devouring a crocodile," by Mr. F. Theodore, 2nd prize. (G) A small model of a marine type, non-condensing, double-acting, vertical engine with reversing gear, by Mr. G. Taylor, 1st prize; a wood pattern of an intercepting valve for a steam wagon, with core-boxes complete, by Mr. R. Pratchett, 2nd prize; and a model showing the method of obtaining a casting of a worm wheel without having any joint in the teeth, by Mr. H. Finch, certificate of merit.

There were also on view a number of other exhibits which were not for competition, amongst which were the following:—A bronze bust of the late George Russell Cockerell, Master of the Founders Company, 1888, by Sir George J. Frampton, R.A.; a collection of castings lent by Mr. Sydney R. Pollard; a bronze casting, representing in full size a sprig of gorse or furze, 5 in. long, modelled, moulded and cast by Mr. Midworth at his foundry at Mansfield, Notts., in 1830, exhibited by Mr. John Place, M.I.Mech.E.; a collection of cast metal work, lent by Messrs. S. B. Goslin & Son, 13, Artillery Lane, Bishopsgate, London, E.; a collection of silver and other castings, lent by Messrs. James Dixon & Sons, Sheffield; a collection of cast and other art metal work, lent by Messrs. Elkington & Company, Limited; and several castings in art metal, lent by Messrs. H. Young & Company, Limited, Nine Elms Iron Works, London.

Handling and Storing Stock Machinery Parts.

The following description, from "The Iron Age," of the methods employed at the works of the United Shoe Machinery Company, Beverley, Mass., U.S.A., will be interesting to foundrymen who have the production, handling and storing of stock parts, such as for machinery construction—a class of work with which is often associated a great loss of time, owing to lack of systematic procedure.

The United Shoe Machinery Company manufactures machinery for making shoes. The machines are as nearly automatic as they can be made, and this means considerable complication in their construction. As the line is extensive, the company has built up in the course of years a very large factory group, the management of which involves a vast amount of detail. The scheme of construction is a series of parallel shops connected by cross bays. All buildings are of reinforced concrete and made as nearly fireproof as possible. In the foundry building the foundry proper is located on the top floor, with the cleaning room, metal pattern shop and other departments on the first floor.

FIG. 1.—BOXES AND RACKS FOR STORING SMALL MACHINE PARTS.

For handling supplies through the factory many useful devices have been originated. For taking care of small pieces at the automatic machines and, in fact, at any of the machines operating on small pieces, strong metal boxes of ordinary black sheet steel are employed. The job card fits in a socket at the end of the box, and each box is provided with runners or slides made of rectangular bar stock. The boxes are taken from one department to another upon suitable trucks, and the machine operators have special stands next to their machines upon which the boxes stand when discharging or receiving stock. Having the stands and the transportation trucks of approximately the same height saves time and makes the handling of the boxes from one to the other much easier.

Small finished parts are stored in galvanised iron boxes in the stock-room. Several styles of boxes have been devised for this purpose and different styles of racks for holding them, depending upon the requirements of the department. Fig. 1 shows on the floor five boxes, illustrating different ways of taking care of variable amounts of stock. This illustration also shows a travelling step ladder used for placing material in the racks or removing it therefrom. At the bottom the step ladder travels on a single track, while at the top a wheel rides against an angle screwed to the ceiling.

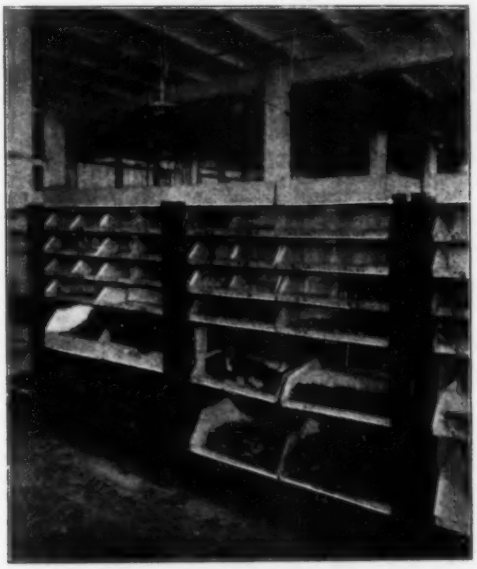


FIG. 2.—RACKS FOR HOLDING MACHINE PARTS IN ASSEMBLING ROOM.

When assembling machines the parts are placed in galvanised iron boxes with open fronts, as in Fig. 2. These boxes, it will be noticed, are carried on trucks rolling upon casters, so that the trucks can be run alongside machines which are being erected.

It may be well to mention the fact that the concrete floors in this factory have been in use for several years, with hundreds of trucks upon wheels or casters passing over them. These floors have given perfect satisfaction, except that in the main runways the surface has become slightly roughened in some places and some joints or corners broken off to such an extent that the joints have had to be repaired. Considering the tonnage which has been handled over these floors and along the runways, the showing for the concrete is remarkable.

For taking care of bar stock in the different departments various styles of racks have been evolved. One

style has cast-iron arms clamped to vertical columns. These racks have proved very satisfactory, but the cast-iron arms take up considerable space and so limit the number of bars which can be piled in a given height. An improved rack, though not adjustable, is constructed of small rounds, which makes it possible to utilise more of the space for stock. Pipe nipples are used about every second horizontal rod, so as to space the rectangular bars which form the vertical divisions.

The storing of sheet stock is always a difficult problem. For certain descriptions, however, racks made up of rectangular bars clamped together, have been found very convenient. One of the advantages of the system is that the amount of stock on hand can be quickly determined at any time.

Some of the constructive features of the building itself are of interest, as illustrating what can be done with concrete. The elevator shafts contain no wood whatever except the elevator gates. In order to provide light in the shafts the panels are made of wire glass. This makes a very light and, at the same time, fireproof shaft. The arrangement of the buildings as parallel shops with connecting wings reduces to a minimum transportation between the various departments by shortening the distance between these departments as much as is consistent with other constructive features. The various courts distributed through the group afford ample light for all the various departments.

The mounting of the cupola on the second floor of the foundry has been entirely successful. The foundry roof is supported by metal construction, though all of the work about the cupolas themselves is reinforced concrete. An overhead conveyor system is provided for carrying the iron from the cupolas to the various moulding floors. In this foundry very little heavy work is done, and hence the departure from the ordinary type of foundry building, which consists of a heavy work bay through the centre and light work bays on the sides. The centre bay through the entire length of the plant is devoted principally to light floor work or to the most difficult hand and machine work. The side bay opposite the cupolas is given up entirely to machines, while the side bay next to the cupolas is divided into sections to suit various classes of work. One of these sections is occupied by the core-room. Others are served by light travelling cranes and handle the heaviest work turned out.

By making the light and intricate castings in the central bay near the cupola it is possible to pour these off with exceedingly hot iron caught direct from the cupola spout in hand ladles or bull ladles. The heavy ladles carried by the overhead trolley system are in most cases used for pouring into bull ladles or hand ladles on the moulding machine floors or other parts of the foundry. On the heavy work floors, however, some castings are poured direct from these heavy ladles.

The Japan-British Exhibition.

Items of Foundry Interest.

The Japan-British Exhibition at the White City, Shepherd's Bush, offers a good many items of interest to the foundryman, though it must be confessed that British foundry art is very poorly represented. In the great building which has come to be known as the Machinery Hall, the British engineering exhibits are housed. These largely consist of textile and similar machinery, though we note that a few of our other well-known engineering firms are represented, including Armstrong, Whitworth & Company, Limited, Vickers, Sons & Maxim, Limited, the Lowmoor Company, the Glasgow Iron and Steel Company, Andrew Barclay, Sons & Company, Limited, John Thompson, of Wolverhampton, and a few more; but the only exhibit of direct foundry interest is that of Messrs. Robert S. Allan & Company, of Gateshead-on-Tyne. This firm are showing their wood-working machine, which we described in our issue of March last. The machine is one which should prove a useful addition to the pattern-shop. For core-boxes and housing, trenching and grooving, the method is very satisfactory. The spindle, to which can be affixed a varied and useful assortment of cutting tools, is run horizontally in a pedestal, which is bolted to the bed-plate, and is free from vibration. The work to be operated is held by powerful clamps on the face of a work table, revolving vertically, and not horizontally, as is generally the case. The stand carrying this work table allows of horizontal movement either to or from the spindle, and also in either direction horizontally across the line of the cutting tool. The machine embodies, in addition, an apparently original idea, which allows the table and work to be moved either up or down vertically in any direction within a range of about 120 degrees. By the simple arrangement of marking the various angles on the flange of the quadrant, the machine can be set to cut or groove at any angle within that range. Another simple arrangement is provided by which the work can be set for circular cutting, all that is necessary being to clamp the work on the table, and a pointer indicates on the scale the radius required in cutting a given circle.

In the Japanese section of the Machinery Hall, amongst a varied collection of exhibits relating to Japanese commerce and industry, are to be seen some excellent specimens of bronze castings. These include numerous collections of bronze figures and ornamental pieces, but of particular note is a model of the Ten-Nó Ji temple, Osaka, Japan. Two fine bronze lions, by T. Hodoto are also worthy of attention, while a series of large lanterns of typical Japanese design and the model of a pagoda are other interesting items. There are also to be seen several fine castings of eagles, but the one of this description which outstrips all the others is situated in another part of the Exhibition. It is a magnificent specimen of bronze work, representing an eagle with outstretched wings on an ornamental rock pedestal, the casting standing in all about 10 ft. high, the measurements from tip to tip of the wings being about 16 ft. It is by Takao & Company, Osaka, and is valued at nearly £600. The finish of the bronze castings shown is worthy of note, and is in keeping with the name the Japanese craftsmen have earned for fine workmanship.

In the building housing the exhibits of the Japanese mining industries are a few further items of foundry interest. Chobei, Tonaka, are showing a selection of pig-irons, speigeleisen, etc., and some specimens of cast-iron pipes, while the Mitsui Mining Department include in their exhibit a sample of beehive-oven coke from Miike Colliery. The Sumitono Steel Works, Osaka, are displaying, amongst other things, a cast-steel cylinder cover, cast-steel ingots, a bevel-gear wheel, a screw conveyor, a loco.-driving wheel, a motor casing, machine-cut gear wheels, and other specimens of cast-steel work. Altogether there are a good few items of interest from the foundry standpoint, though they are somewhat scattered.

American Foundrymen's Association.

Fifteenth Annual Convention.

The annual joint Convention of the American Foundrymen's Association and the American Brassfounders' Association and allied organisations, was held on June 7-10, at Detroit, Michigan, U.S.A. The proceedings began with the Presidential addresses of Mr. Arthur T. Waterfall, President of the American Foundrymen's Association, and of Mr. Wm. R. Webster, President of the American Brassfounders' Association. Then followed the Secretary and Treasurer's reports, by Mr. W. M. Corse, for the A.B.F.A., and by Dr. Richard Moldenke, for the A.F.A., after which the following Paper was presented: "Acetylene-Oxygen Repairs in the Foundry," with an exhibition of the art as practically applied, by Steelman Stephenson, of Detroit.

At the second session on Tuesday the following Papers were presented before the American Brassfounders' Association:—"Analyses of Lead in Brass Alloys," by C. P. Carr, New Cork City; "Fluxes as Applied to the Brass Foundry," by Wm. R. Sperry, Bridgeport, Conn.; "Use of Magnesium in Deoxidising Aluminium Alloys," by H. M. Lane, Cleveland; "Foundry Efficiency," by Benjamin D. Fuller, Cleveland; "The Personal Equation in Accidents," by Thomas D. West, Cleveland; "The Permanent Mould," by Edgar A. Custer, Philadelphia, illustrated by lantern slides.

On Wednesday the programme of the third session of the Convention included the following Addresses and Papers presented before the American Brassfounders' Association:—Address on "Brass Foundry Practice," by Jesse L. Jones, Pittsburg, Pa.; "Electric Power Required to Melt Brass, Bronze, etc.," by Prof. J. W. Richards, South Bethlehem, Pa.; "Electric Furnaces for Melting Non-ferrous Alloys," by A. L. Marsh, Detroit, Mich.; and the following before the American Foundrymen's Association:—Report of Committee on Chemical Standards for Iron Castings, by Prof. J. J. Porter, Cincinnati; "Physics of Cast Iron," by H. M. Lane, Cleveland. The business session was followed by a pleasure boat ride on Detroit river, the steamer stopping at the Semet-Solvay coke ovens and Detroit Iron and Steel Company's blast furnaces, then continuing down the river to see the Government work on Livingstone Channel.

The following items were included in Thursday's programme:—Papers presented before the American Brassfounders' Association; "The Value of the Association to Its Members," by Frank T. F. Stephenson, Detroit; "Co-operative Course of Metallurgy," by Prof. J. J. Porter, Cincinnati; "Cost and Cost Systems Applied," by C. R. Stevenson, New York City. Papers presented before the American Foundrymen's Association: "The Shockless Jarring Machine," by Wilfred Lewis, Philadelphia; "The Universal Principle of Efficiency and Rational Organisation Applied to Foundry Practice," by S. D. Emerson and W. J. Powers, New York City. On Thursday afternoon the American Foundrymen's Association met to consider the reports of Committees, the election of officers, etc. The following Papers were also then presented:—"Overhead Tramrail Systems for the Foundry," by A. W. Moyer, Philadelphia, illustrated by lantern slides; "The Electric Furnace," by H. M. Lane, Cleveland, illustrated by lantern slides.

On Friday, the final day of the Convention, the programme included the following, before the American Foundrymen's Association:—"Foundry Transportation Methods," by David Gaehr, Cleveland; Report of Committee on Industrial Education, by P. Kreuzpointer, Altoona, Pa.; "Specifications for Foundry Coke," by Dr. Richard Moldenke, Watchung, N.J.; Discussion of continuous conveying methods and foundry mixer.

Secretaries' Reports.

Mr. W. R. Webster, of the American Brass Founders' Association, in his Presidential address, pointed out the need of classified data and the limited information obtainable on the art of casting non-ferrous metals. The report of Mr. W. G. Corse, Secretary and Treasurer of the organisation, showed an increase in membership from 206 to 273 during the year. He reported that the Committee on Standardisation of Alloys had been working with the United States Bureau of Standards, and he recommended that the Committee also co-operate with the American Chemical Society and the American Society for Testing Materials. He described the steps that were being taken with the view of obtaining a definition of trade terms for the non-ferrous industry.

Dr. Moldenke, in the course of his report as secretary-treasurer of the American Foundrymen's Association said:—

In the past year I found it necessary to go to Europe twice. The second trip was a short one, for business in foundry matters, and I took occasion to look particularly into the difference between German and American foundry practice. If I can point to but one great difference in practice, it is that Germans—and, I understand, the English also—make their castings entirely for the work intended, no matter if the machine shop kicks about hard castings. If they want wear they make their castings in accordance therewith, and no excessive machine shop costs, as we might think them, are allowed to stand in the way. A little of this method would do us good here, where the foundryman is constantly on thin ice when he sends out his castings to a machine shop. We are too much after soft castings here, as you all can testify. Further, when going into the question of pig-irons, strange to say their better brands—and more expensive ones—are all of the rather lower silicon varieties. Quite evidently they still believe in paying high for an imported metal that has a name for making strong castings. Some day the fact that other irons with low silicon will do the same will be recognised, and then our practices will get closer together. To turn now to internal affairs. The Association now has 753 members, which number excludes those who are in bad standing and cannot be got to pay up their annual dues. What effect the raising of the annual dues to $10 will have remains to be seen. Let us hope that it will not materially affect the membership, particularly as it is the intention to enlarge the "Transactions," and to furnish a bound volume at the end of the year. This action, now that the vote has passed it, was highly necessary, for although the books show a balance, if the absence of the secretary for three months in Europe had not meant that the Association was under no expense during that time, there would probably have been a deficit to show. This will be noted from the expense now necessary for

convention arrangements, and the enormous work of the office, requiring, as it did, the round sum of $500 in postage.

The finances of the Association are as follows:—

	Dols.
Balance from last year	28.64
Income during year	2,940.00
Total	2,968.64
Expense for Transactions	1,178.53
Printing	135.75
Postage	500.00
Salaries	900.00
Convention expenses	222.47
Sundries	11.61
Total	2,948.36

This leaves a balance of $20.28 to report to the Association.

At the conclusion of Dr. Moldenke's report, which showed an expense of only $900 for salaries during the year, it was suggested by Mr. Seaman that, in view of the fact that a salary of $1,200 is allowed the secretary and treasurer by the Association, they insist upon the acceptance by Dr. Moldenke of the balance due.

Election of Officers.

At the last Session of the Convention on Friday morning, an invitation was extended to hold the next annual meeting in Pittsburg, and a resolution was adopted instructing the Executive Committee to make the necessary arrangements. The President was empowered to appoint a committee of five who will have charge of the educational programme for the next meeting. The Committee will arrange for Papers, thus relieving the Secretary of a large amount of work which he was called upon to perform in the past. A Committee of two will also be appointed to audit the books of the organisation. Arthur T. Waterfall, Retiring President, was then elected an honorary member of the American Foundrymen's Association.

Officers of the A.F.A. for the ensuing year were elected as follows:—President, Mr. Joseph T. Speer, Pittsburg Valve, Foundry and Construction Company, Pittsburg. Vice-Presidents: Messrs. F. B. Farnsworth (McLagon Foundry Company, New Haven, Conn.), Walter Wood (R. D. Wood & Company, Camden, N.J.), W. A. Bole (Westinghouse Machine Company, East Pittsburg), William Gilbert (Buckeye Foundry Company, Cincinnati), J. J. Wilson (General Motors Company, Detroit), T. W. Sheriffs (Sheriffs Manufacturing Company, Milwaukee), Alfred E. Howell (Phillips & Buttorf Manufacturing Company, Nashville, Tenn.), and A. N. W. Clare (Clare Stove Company, Preston, Ont.); Secretary-Treasurer, Richard Moldenke (Watchung, N.J.).

Officers of the A.B.F.A. for the ensuing year were elected as follows:—President, Mr. N. K. B. Patch (Lumen Bearing Company, Toronto, Ont.); Vice-Presidents: Messrs. Thomas Evans (Eynon-Evans Manufacturing Company, Philadelphia), W. H. Carpenter (Bristol Brass Company, Bristol, Conn.), Richard Augenbraun (Yale and Towne Manufacturing Company, Stamford, Conn.), W. L. Abate (Nathan Manufacturing Company, New York City), L. W. Olson (Ohio Brass Company, Mansfield, O.), J. N. Gamble (National Tube Company, Kewanee, Ill.), John Wolff (L. Wolff Manufacturing Company, Chicago), J. Cessna Sharp (J. C. Sharp, Brass Works, Chattanooga, Tenn.), Murray Woodbridge (General Brass Works, Toronto), Richard R. Mitchell (Robert Mitchell Company, Limited, Montreal, Can.); Secretary-Treasurer, Mr. W. M. Corse (Lumen Bearing Company, Buffalo).

Specifications for Foundry Coke.*

By Dr. Richard Moldenke.

The subject of specifications for foundry coke has been long agitated, but very little so far has been accomplished; and this probably because we have been going through just such a change in practice in our coke as we have in our pig-irons ever since more liberal and yet more exact views have prevailed. The appearance of a coke no longer carries the weight it formerly did, and all that is now asked is that it melts iron properly, and has a composition to do this without serious detriment to the metal. This change in practice has undoubtedly been the result of the educational efforts of the by-product coke manufacturers, and as it has meant the saving of much money formerly spent in freights the foundry industry has been the gainer in every direction on the coke item.

There is still much to be learned by the foundryman regarding the fuel he uses for melting purposes. Too often the blame for poor results is placed on the coke, when the real trouble lies in his melting practice. So that there may be no doubt about the fuel end, it is highly advisable that a good and yet liberal set of specifications for foundry coke be drawn up, so that coke bought under them may assure the foundryman reasonable safety. If then he runs into trouble he will have eliminated the coke from his study of the difficulty.

Furnace Coke and Foundry Coke.

There are many points which have a bearing on the value of a coke and yet cannot well be added to such specifications. Thus, the cellular structure is an important factor on the working of the coke in the cupola. It must be remembered that in contradistinction to blast furnace practice, where there is a reducing atmosphere, in the cupola it is oxidising. In the blast furnace the cellular structure of the coke should be as great as possible, so that every molecule of oxygen is used up in burning the carbon, and with an excess of incandescent carbon make carbonic oxide gas. This means that the lighter the coke, consistent with its carrying power, and the more porous, the better.

On the other hand, for foundry purposes it is desirable that coke be burned with a slight excess of oxygen, as in boiler practice, so that as complete a combustion of the fuel as possible may result. That is, the gas should be carbonic acid, with but little carbonic oxide. This can best be accomplished by presenting smaller surfaces to the passing oxygen. For that reason the smooth surfaces of anthracite, with no cellular structure whatever, give a most excellent fuel for the cupola, though coke can be burned faster.

Considering average coke to be 50 per cent. cellular structure, the blast furnace can take care of higher percentages, while the cupola should have them lower. Very light cokes are, therefore, to be avoided, and rather the denser, heavier ones—provided the weight does not come from an excess of ash—are to be recommended.

On the question of sulphur we have still something to learn. As between the volatile sulphur and that fixed in the ash of coke, we do not yet know positively why sometimes with the latter we get more into our castings and at other times proportionately less. We know that temperatures and slag conditions have much to do with this; but until we are more certain, a differentiation of the sulphur content of a coke is not yet safe, the idea being that the dangerous portion of the sulphur only need be kept down.

Further, there is no doubt that we will eventually

* Read at the Detroit meeting of the American Foundrymen's Association, June 9, 1910.

have some means of reducing the sulphur in our molten iron before pouring, and then sulphur in coke will lose some of its terrors.

Suggested Specifications for Foundry Coke.

Coke bought under these specifications should be massive, in large pieces and as free as possible from black ends and cinders.

Sampling.

Each carload or its equivalent shall be considered as a unit, and sampled by taking from the exposed surface at least one piece for each ton, so as to fairly represent the shipment. These samples, properly broken down and ground to the fineness of coarse sawdust, well mixed and dried before analysis, shall be used as a basis for the payment of the shipment. In case of disagreement between buyer and seller an independent chemist, mutually agreed upon, shall be employed to sample and analyse the coke, the cost to be borne by the party at fault.

Base Analysis.

The following analysis, representing an average grade of foundry coke capable of being made in any of the districts supplying foundries, shall be considered the base, premiums and penalties to be calculated thereon as determined by the analysis on an agreed base price:—

Volatile matter ...	...	1.00	Ash		12.00
Fixed Carbon ...	...	85.50	Sulphur		1.10

Penalties and Bonuses.

Moisture.—Payment shall be made on shipments on the basis of "dry coke." The weight received shall, therefore, be corrected by deducting the water contained. (Note.—Coke producers should add sufficient coke to their tonnage shipments to make up for the water included, as shown by their own determinations.)

Volatile Matter.—For every 0.50 or fraction thereof, above the 1.00 allowed, deduct . . cents from the price. Over 2.50 rejects the shipment at the option of the purchaser.

Fixed Carbon.—For every 1.00 or fraction thereof, above 85.50 add, and for every 1.00 or fraction thereof below 85.50, deduct . . cents. Below 78.50 rejects the shipment at the option of the purchaser.

Ash.—For every 0.50 or fraction thereof below 12.00, add, and for every 0.50 or fraction thereof above 12.00, deduct . . cents from the price. Above 15.00 rejects the shipment at the option of the purchaser.

Sulphur.—For every 0.10 or fraction thereof below 1.10 add, and for every 0.10 or fraction thereof above, deduct . . cents from the price. Above 1.30 rejects the shipment at the option of the purchaser.

Shatter Test.

On arrival of the shipment the coke shall be subjected to a shatter test, as described below. The percentage of fine coke thus determined, above 5 per cent. of the coke, shall be deducted from the amount of coke to be paid for (after allowing for the water), and paid at fine coke prices previously agreed upon. Above 25 per cent. fine coke rejects the shipment at the option of the purchaser. Fine coke shall be coke that passes through a wire screen with square holes 2 in. in the clear.

The apparatus for making the shatter test should be a box capable of holding at least 100 lb. coke, supported with the bottom 6 ft. above a cast-iron plate. The doors on the bottom of the box shall be so hinged and latched that they will swing freely away when opened, and will not impede the fall of the coke. Boards shall be put around the cast-iron plate so that no coke may be lost.

A sample of approximately 50 lb. is taken at random from the car, using a 1¼ in. tine fork, and placed in the box without attempt to arrange it therein. The entire material shall be dropped four times upon the cast-iron plate, the small material and the dust being returned with the large coke each time.

After the fourth drop the material is screened as above given, the screen to be in horizontal position, shaken once only, and no attempt made to put the small pieces through specially. The coke remaining shall be weighed and the percentage of the fine coke determined.

If the sum of the weights indicates a loss of over 1 per cent. the test shall be rejected and a new one made.

Rejection by reason of failure to pass the shatter test shall not take place until at least two check tests have been made.

Chemical Standards for Iron Castings.*

The sources of this data are three in number; first, published work; second, the private notes of the writer; third, the replies to the inquiries sent out by your committee. Regarding this last source, which has supplied the greater number of analyses, approximately 1,000 inquiries were sent out to as many different foundries, selected largely at random from "Penton's List." These inquiries ran in substance as follows:—

"At the last Convention of the A.F.A. it was decided to make an attempt to formulate chemical standards for iron castings. The information on which these should be based could, of course, be obtained by analysing typical castings bought in the open market. This would, however, involve much trouble and expense, and will be unnecessary if foundrymen will freely donate the information for the good of the industry.

We urge you, therefore, to act generously in giving us the following data:—Name or class of castings, silicon, sul., phos., mang., comb. carb., graph. carb., total carb."

To this letter about 10 per cent. of replies were received, the greater number of which contained more or less information. Regarding the classification of castings, it is evidently impossible to consider as separate cases all the different patterns. Nor would this be desirable, since any foundry must itself class its castings into comparatively few groups which are each poured from one kind of iron. For example, a shop doing machine-tool work may make castings from several hundred patterns, and will use not more than four mixtures of iron for all of these, probably dividing the work into light, medium, and heavy castings, with possibly a special mixture for pulleys. It is thought, therefore, that a classification according to use or properties necessary is in the majority of cases desirable. Thickness is, of course, taken into consideration, since this largely determines the percentage of silicon necessary, and it has been the aim to subdivide the various classes according to section wherever possible. In this respect the writer has endeavoured to follow the definitions of the American Society for Testing Materials, who have grouped castings according to thickness as follows: (126).

* Extract from the Report of the Committee of the American Foundrymen's Association on Standards for Iron Castings. By Dr. John Jermain Porter, University of Cincinnati.

"Castings having any section less than one-half of an inch thick shall be known as light castings."

"Castings in which no section is less than 2 in. thick shall be known as heavy castings."

"Medium castings are those not included in the above definitions."

It is unfortunately true that there is much lacking in this table, many important classes of castings being entirely missing, while others are inadequately represented by only one or two analyses. These deficiences are due to the lack of available data in certain cases, and it is to hoped that they may be at least partially remedied by future work. Malleable cast iron is omitted entirely, partly because of the small amount of data obtained and partly because its manufacture is a process entirely different from those involved in the ordinary iron foundry.

Regarding arrangement, the analyses taken from published sources are preceded by a number in the first column referring to the bibliography, Part V. The last analysis under each head is preceded by the word "Sug." (suggested) and is the tentative standard or probable best analysis suggested by your committee. It should be clearly understood in this connection that while this is based on careful study of both theory and practice, it represents only the individual opinion of the writer, and is not necessarily infallible. Furthermore, these suggestions are incomplete in certain other respects. The most desirable percentage of silicon, for example, will depend largely on the exact thickness of the casting and the practice followed in shaking out. These factors, being in many cases undetermined, have been allowed for by giving fairly wide limits to this element. Again, the possibilities in the use of purifying alloys have not been taken into account here, although they have been discussed in the preceding parts, and the use of steel scrap has been ignored except that the "low" total carbon specified in some cases must, as a rule, be obtained in this way. Finally, in many cases, a very wide range of composition is permissible and compatible with the best results, and in such cases the question of cost will be the first element to be considered in fixing the composition.

Ref.	Silicon Per cent.	Sulphur Per cent.	Phos. Per cent.	Mang. Per cent.	Comb. Carb. Per cent.	Total Carb. Per cent.
Acid Resisting Castings						
7	1.00	.050	.50	—	—	3.00
42	2.30	low	.20	.41	—	3.60
81	.80-2.00	.02-.03	.40-.60	1.00-2.00	—	3.00-3.50
Sug.	1.00-2.00	und. .05	und. .40	1.00-1.50	—	3.00-3.50
Acid Stills and Eggs: See Acid Resisting Castings						
Agricultural Machinery, Ordinary						
64	2.20-2.80	und. .085	und. .70	und. 70	—	—
—	2.65	.050	.81	.70	.15	3.50
—	2.25	.070	.70	.80	.30	3.50
—	2.10	.068	.73	.45	.47	3.42
—	2.60	.089	.89	.46	.50	3.39
Sug.	2.00-2.50	.06-.08	.60-.80	.60-.80	—	—
Agricultural Machinery, Very Thin						
—	2.90	.050	.85	.70	.10	3.50
—	2.50	.080	.65	.60	.30	3.50
Sug.	2.25-2.75	.06-.03	.70-.90	.50-.70	—	—
Air Cylinders						
64	1.50-1.50	und. .09	.35-.60	.50-.80	—	—
—	1.90	.074	.50	.65	—	—
—	1.12	.045	.40	.70	.70	3.53
—	.95	.100	.30	.90	.80	3.40
—	2.00	.070	.30	.60	.40	—
Sug.	1.00-1.75	und. .09	.30-.50	.70-.90	—	3.00-3.30
Ammonia Cylinders						
14	1.30-1.90	und. .09	und. .70	.60-.80	—	—
Sug.	1.00-1.75	und. .060	.30-.50	.70-.90	—	3.00-3.30
Annealing Boxes, Pots and Pans						
171	1.20	.050	.10	.40	—	—
81	1.80	.03	.70	.60	—	2.90
193	1.53	.01	.33	1.08	.58	3.68
Sug.	1.40-1.60	und. .06	und. .20	.60-1.00	—	low
Automobile Castings						
—	1.80	.030	.50	.70	.60	3.50
—	1.65	.076	.45	.65	.55	—
—	2.35	.072	.60	.70	.40	—
Sug.	1.75-2.25	und. .03	.40-.50	.60-.80	—	—
Automobile Cylinders						
—	1.65	.076	.45	.65	.55	—
19	2.31	.091	.50	.43	.51	3.35
19	2.70	.053	.46	.23	.44	3.02
19	2.45	.102	.72	.41	.41	3.47
19	2.50	.083	.57	.47	.11	3.35
19	2.55	.104	.82	.32	.09	3.04
19	2.98	.047	.89	.27	.14	3.19
19	2.67	.111	.73	.38	.10	3.24
19	2.30	.084	.81	.52	.59	3.35
19	1.60	.083	.54	.42	.66	3.75
19	3.26	.150	.93	.44	.03	2.87
19	1.72	.091	.53	.48	.62	2.52
19	1.67	.068	.44	.82	.62	3.91
19	1.38	.093	.62	.52	.76	3.61
19	1.47	.075	.13	.60	—	—
19	1.50	.103	.86	.43	—	—
19	1.99	.130	.65	.39	.45	3.17
19	1.80	.060	.70	.39	.77	3.34
19	2.29	.090	.83	.60	.90	4.16
Sug.	1.75-2.00	und. .08	.40-.50	.60-.80	.55-.65	3.00-3.25
Automobile Fly Wheels						
—	2.35	.072	.60	.70	.40	—
—	3.10	.045	.35	.55	.27	—
Sug.	2.25-2.50	und. .07	.40-.50	.50-.70	—	—
Balls for Ball Mills						
196	1.00	.100	.30	.50	—	low
Sug.	1.00-1.25	und. .08	und. .20	.60-1.00	—	low
Bed Plates						
—	2.20	.090	.55	.50	—	—
—	1.32	.030	.40	.60	—	—
—	1.65	—	.28	.92	.72	—
—	1.85	.080	.60	.55	.50	3.25-3.50
—	1.80-2.20	.04-.06	.45-.55	.40-.50	.40-.50	3.40-3.60
—	1.65-1.85	.070	.65-.80	.60-.75	—	3.85
Sug.	1.25-1.75	und. .10	.30-.50	.60-.80	—	—
Binders. See Agricultural Machinery						
Boiler Castings						
194	2.50	und. .07	und. .20	.80-1.0	—	—
—	2.25	.060	.62	.50	—	—
Sug.	2.00-2.50	und. .06	und. .20	.60-1.0	—	—
Brake Shoes						
95	1.50	—	low	—	—	low
64	2.00-2.50	und. .15	und. .70	und. .70	—	—
57	2.00-2.50	und. .15	und. .70	und. .70	—	—
—	1.40-1.80	.06-.08	.50-.80	.45-.60	.40-.65	3.50
—	1.86	.183	1.93	.33	1.22	3.01
Sug.	1.40-1.60	.08-.10	.30	.50-.70	—	low
Car Castings, Gray Iron. See also Brake Shoes and Car Wheels						
64	2.20-2.80	und. .085	und. .70	und. .70	—	—
—	1.40-1.80	.06-.08	.50-.80	.45-.60	40-.65	3.50
—	2.25	.050	.60	.75	—	3.50
—	1.75	.070	.85	.60	—	—
Sug.	1.50-2.25	und. .08	.40-.60	.60-.80	—	—

(To be continued.)

British Foundrymen's Association: Birmingham Branch.

Annual Meeting.

The annual meeting of the Birmingham Branch of the British Foundrymen's Association was held on Saturday, June 18, at the Imperial Hotel, Birmingham, and at the conclusion of the business an interesting address (illustrated by models, on "Aeroplanes," was given by Mr. F. J. Cook (President of the British Foundrymen's Association). Mr. R. Mason (retiring President of the Branch) in the chair said that the Council had very kindly asked him to accept re-election as President of the Branch, but, unfortunately, he now resided so far from Birmingham that he was unable to accept the nomination.

Mr. C. Heggie, the retiring Hon. Secretary, presented the statement of accounts, showing that the total expenditure of the Branch during the present financial year expiring on December 31 had, so far, been £7 3s. 5d. He had no income to report, as all the subscriptions went to the central office, which made a grant to the Branch for its expenses. On the motion of Mr. F. J. Cook, it was resolved that the accounts,

as presented by Mr. Heggie, and audited, be adopted, and that the balance of the Convention Entertainment Fund (£4 10s. 1d.) be held over at the disposal of the Branch Council.

The President said that in making recommendations for the election of officers, the Council had gone into the matter very carefully, with a view of obtaining not only the best men, but those who would be able to attend regularly, and give their time to the business of the Association. He did not think the members would be able to better the choice that had been made. They had had a very successful session, and that was due mainly to the work of the Council, but especially to one or two members, for example, their Hon. Secretary and Mr. F. J. Cook. He had great pleasure in proposing that Mr. A. H. Hiorns, Principal of the Metallurgical Department, Technical School, Birmingham, be elected President for the coming year. Mr. Hiorns had attended their meetings regularly, and had been a great help to them from the beginning, and in every way had done all he could to assist the Association. Although he was not a foundryman in the ordinary sense, there was no foundryman who had taken a greater interest in the Association than he had. Many of them had had the pleasure of being students under Mr. Hiorns, and they could not overrate the good they had received from his teaching. (Hear, hear.) They were indebted to Mr. Hiorns, also, for arranging that their meetings should be held at the Municipal Technical School, and procuring them the use of the lantern. He thought they would all agree that in Mr. Hiorns the Branch would have an ideal President. (Applause).

Mr. F. J. Cook, in seconding the motion, said that although Mr. Mason had referred to Mr. Hiorns as not being a foundryman, that gentleman was very closely associated with the trade, and had done great service to it as a metallurgist. The services he had rendered to that Branch and the Asociation generally had been recognised by the fact that at the last general Convention he was made a Life Honorary Member. (Applause.) He (Mr. Cook) did not think that there was any man who could conduct their business better or who would show a more lively interest in their work. (Applause.)

The election was carried unanimously, the President remarking that Mr. Hiorns would have been very pleased to have been present at their annual meeting, but was away on his holidays.

The next election was that of Vice-President, and the Council had decided to recommend that they have two Vice-Presidents instead of one as formerly. Mr. Tattersall then proposed Mr. H. L. Reason as a Vice-President for the ensuing year. Mr. Buchanan said he had very great pleasure in seconding the nomination, especially as a recognition of the principle of electing to the offices new men who had been doing good work for the Association.

Mr. C. Evans then proposed the election of Mr. Heggie as one of the Vice-Presidents. The proposal, he was sure, would be heartily approved by all who knew the splendid work Mr. Heggie had done as Secretary of the Branch. The motion was seconded by Mr. Hailstone, and the two nominations were agreed to with acclamation.

The President said that Mr. Heggie unfortunately was compelled to resign the office of Hon. Treasurer and Secretary, as he found himself unable any longer to devote the necessary time to it.

Mr. Bullock then proposed Mr. Hailstone as Hon. Secretary and Treasurer. Mr. F. E. Robinson seconded the motion, and remarked that as Mr. Hailstone had been a good man to give them Papers, he would probably prove a very good man as Secretary to get Papers

The motion was carried with applause.

The President said that they had now to elect the Council. The members during the past Session had been Messrs. Cook, Tattersall, Matthews, Gale, Buchanan, Mason, and Fraser. According to their previous practice they should have ten members of the Council, including the President, the two Vice-Presidents and the Hon. Secretary. As he was now out of the district, the members eligible for re-election apart from those who had already been elected as officers, were Messrs. F. J. Cook, J. B. Tattersall, J. Matthews, Walter Gale, and R. Buchanan.

On the motion of Mr. C. Evans, seconded by Mr. Robinson, it was unanimously decided that these five be re-elected.

Mr. Heggie, proposed, to fill the vacancy, Mr. J. Bullock, who, he said(had been a hard worker for the Association ever since it had been in existence. Mr. Neish seconded the nomination, which was supported by Mr. Reason.

The President said that the Council was not necessarily restricted to the number they had elected, and in reply to questions said that membership of Council was not limited to full members of the Association. He though all classes of membership should be represented. Their anxiety was to get into the Association all who were associated with foundry work. The Branch had made considerable progress, but not so much as could be desired, and they had not yet got all the foundrymen in the district into the Association, neither had they got all the foundry officials. They should not rest satisfied until they had got all the officials, and at least a great many more of the foundrymen into the Association. They wished all to take part in the work, and that was why they were anxious that associates should be elected members of the Council.

Mr. F. J. Cook agreed with Mr. Mason that it would be quite wise to increase the number of members on the Council. Fortunately, those who had already been members had been able to attend regularly, but he thought, and the other members of the Council agreed with him, that it would be desirable to have a somewhat larger number in order to be certain of a good attendance.

Messrs. Deaville and Robinson were nominated as additional members of the Council, and these two gentlemen were unanimously elected.

Mr. H. Winterton proposed a vote of thanks to the officers and the Council for their services during the past year. Mr. Buchanan, in seconding the motion, said he thought, and the other members of the Council agreed with him, that their sense of the value of Mr. Heggie's services as Hon. Secretary and Treasurer should be marked in some special way, and he hoped that one of the first duties of Mr. Heggie's successor would be to communicate with the members and arrange some time between then and the opening of the next Session for this recognition to be made.

Mr. Reasons supported the vote of thanks, and also the suggestion made by Mr. Buchanan. The vote of thanks was carried by acclamation, the President remarking that no doubt the Council would carry out the suggestion made by Mr. Buchanan. (Applause.)

The compliment was acknowledged by Mr. Heggie, and by Mr. Mason, the latter explaining that he had been out of the district since August last, but he had been able to attend all the meetings except one. He thanked them for the kindness and support which had been accorded to him during the year of his Presidency.

Our report of Mr. F. J. Cook's address on "Aeroplanes" is unavoidably held over until our next issue.

Refractory Materials for Furnace Construction.

At a meeting of the Birmingham Metallurgical Society, held at the Municipal Technical School, on May 31, the subject for discussion was "Refractory Materials." Mr. A. H. Hiorns (Vice-President) was in the chair.

The discussion was opened by Mr. J. H. Stansbie, B.Sc., F.I.C., who dealt with the refractory properties of lime, magnesia, carbon, and dolomite, and with the uses of these materials in electric furnace practice. These, he said, were the most satisfactory materials for resisting very high temperatures, both for experimental work and for smelting processes on a large scale. Moissan's experiments in connection with the refractory characters of lime, magnesia and carbon were very instructive. Working at the temperature of the electric arc, which was in the region of 3,500 degrees C., he found that the only refractory substance that was not liquefied under these conditions was carbon. Therefore, nothing could remain solid in the electric hearth except the carbon rods between which it was formed, and even these were rapidly volatilised without passing through the liquid state. The highest temperature obtained by the combustion of ordinary fuel was that developed by the burning of hydrogen or coal gas in pure oxygen, and this temperature is estimated at 2,000 degrees C. Silica and refractory silicates melted readily in the oxy-hydrogen flame and so were excluded from use for temperatures above 1,700 degrees C. Lime, CaO, when pure showed no signs of fusion or even softening at 2,000 degrees C., but when exposed to the temperature of the electric arc it melted readily and volatilised. Moissan found that with a current of 800 amperes at a pressure of 110 volts he could volatilise over 100 grammes of lime in five minutes. An idea of the rapid evolution of heat in the arc was obtained if it was borne in mind that the energy of the current Moissan used was equal to 118 h.p. It was evident, then, that with an arc furnace in which lime formed the lining material, the lining would gradually disappear by volatilisation. It was to be remarked, however, that it was only when the furnace cavity was very small that the volatilisation of the lime was rapid. As the size of the furnace space increased, the power absorbed remaining the same, the temperature of the walls increased, and only glazing of the surface took place. The low conductivity of lime for heat was an important factor in the use of this material for high temperature work, as it allowed practically the whole of the heat developed in the furnace space to remain there, with consequent increase in temperature. The reaction, however, which took place between lime and carbon at electric arc temperatures, by which calcium carbide was formed, limited its use when carbon had to come into contact with the furnace lining. This difficulty might be avoided by the use of magnesia in place of lime, as that compound did not react with carbon to form a carbide. On the other hand, magnesia was a good conductor of heat compared with lime, and this was a drawback to its use when the highest temperature was to be obtained. Moissan, however, got over the difficulty by using plates of magnesia backed by blocks of lime to prevent the escape of heat. Another method was to use carbon plates for the inside lining with thin plates of magnesia between the carbon plates and the lime blocks, so as to prevent the reaction between the carbon and the line. Carbon was the best material for resisting the highest temperatures. The principal objection to the use of carbon for furnace linings was that metals brought into contact with it often took up some of the carbon and were thus rendered impure. For special work materials of a high degree of purity were necessary as the presence of impurities, especially silica, deteriorated the refractory properties. But for ordinary work the presence of silica and other oxides was often an advantage, as a cementing material was formed by the combination of the silica with small quantities of oxides and the blocks or bricks were rendered more durable after being strongly heated. Of a magnesite brick, which he (Mr. Stansbie) was now using, he had had supplied to him by Messrs. Grayson, Lowood & Company, of Deepcar, through their representative Mr. Russell, the following analysis:—Magnesia, MgO., 91.06; silica, $Si.O_2$, 4.44; oxide of iron, Fe_2O_3, and alumina, Al_2O_3, 2.8.

In resistance arc furnaces, as used on the large scale, the temperatures reached were much lower and dolomite lime was a much-used material, especially for bed linings. The presence of silica in such material was necessary if it was to possess good working properties.

Mr. E. P. Page and Mr. A. Spittle, who had been announced to take part in the discussion, were unable to be present, but each sent notes, which were read and amplified by Mr. W. J. Rees (one of the Hon. Secretaries).

Mr. E. P. Page, dealing with the general properties of refractory materials, said it was now generally recognised that the chemical analysis was not an infallible guide in the matter of refractoriness. The actual pyrometric test in addition to the analysis was now more commonly considered necessary. Further, the old idea that the more silica there was in a fireclay or in the material from which silica bricks were made, the better, would gradually disappear. They had learnt by experience that the methods of manufacture played a very important part, and that however good a clay might be theoretically great discrimination was necessary to adapt the method of manufacture to the purposes for which the bricks might be used. As to silica bricks, his friend Mr. F. Wernicke, of Wiesbaden, had shown that the important constituent in rocks used in this manufacture was not the quartz but the matrix in which the quartz grains were embedded, and that material actually lower in the scale of refractoriness than pure quartz had an effectual refractoriness when in use far higher. This particular investigation was not yet complete. Another series of experiments in hand at the Königlichen Materialprüfungsamt at Goss-Lichterfelde, West, was also of great interest, especially to those connected with blast furnaces. The lower courses of bricks in hot-air stoves were subject to great pressure from the mass of brickwork above, and failures had resulted from the lower course crushing and crumbling away. Bricks were obtained from all the makers who were interested in the solution of the problem. Whole bricks were first tested by crushing in the usual way. Then small cylinders 5 centimetres in diameter and 5 centimetres high were cut from the bricks with a hollow diamond drill. Some of the cylinders were tested cold and the others at 1,000 degrees C., with the following results:—

Whole brick cold	195	kilog.	per	sq.	c.m.	=	2,773	lbs. per sq. in.
Cylinder	169	,,	,,	,,	,,	,,	2,403	,, ,, ,,
(average of 5)								
,, 1,000° C.	218	,,	,,	,,	,,	,,	3,100	,, ,, ,,
(average of 3).								

The tests were carried out in a specially arranged electric furnace. The increased strength at 1,000 degrees C. was remarkable. Many other tests had yet to be made, such, for instance, as repeatedly heating and cooling under pressure.

Mr. A. Spittle, who dealt more especially with materials for copper work, said that the chief refractory materials used in the brass and copper trade were Stourbridge firebricks and clay, silica bricks and silica cement, clay crucibles, and plumbago crucibles. The Stourbridge bricks and clay were used for lining the fire-boxes and bodies of annealing furnaces, the inside of flues and chimneys, etc., and crucible melting furnaces. Silica bricks and cement were used in the construction of copper smelting and refining furnaces. Clay crucibles were used for melting brasses having a comparatively low content of copper and also for melting nickel alloys. Plumbago crucibles were used for melting copper and mixed brasses, etc.

The duty imposed on Stourbridge bricks was not exceptionally severe. The highest temperature they had to withstand was in crucible melting furnaces and the fire-boxes of annealing muffles. Some bricks softened and sometimes melted close by the side door, more especially if the door was not a close fit, the damage taking place at those points where a small current of air entered. Other bricks did not suffer in this respect and yet showed no further superiority in their quality. It was a practice of some furnacemen to turn a jet of water on to a firebar when cleaning off a fire, to harden the clinker and so enable them to get it out easily. This was not good for the firebricks, but the actual effects were somewhat strange. The bricks wore away in deep vertical grooves; these grooves did not follow the joints, but went straight across the face of the bricks. It would be interesting to know why the damage took this form. To one who used bricks from various manufacturers it was evident that the Engineering Standards Committee had not yet turned their attention to brickmaking.

An ordinary firebrick should measure 2½ in. by 4½in. by 9in. Some makers kept their bricks well up to the size whilst others made them small. It was not an unheard-of thing to get bricks measuring 2¼ in. by 4¼ in. by 8¾in. The difference did not appear to have much importance at first sight, but it was surprising what it amounted to when spread over a large number. One thousand bricks of full size measured 58 1/2 cubic feet, one thousand bricks 2¼ by 4¼ in. by 8¾ in. measured 48 5/12 cubic feet. Assuming firebricks to be worth 1s. per cubic foot, then the relative values would be 58s. 7d. per thousand for the full-sized against 48s. 5d. for the small. Again, a bricklayer would lay just as many large bricks in day as small ones, so that the builder obtained 58 1/2 cubic feet of work in the one case for the same price as 48 1/12 cubic feet. Further, small bricks might be bought to repair a furnace originally constructed with full-sized bricks. It was then found that the small bricks would not bond properly with the original ones. As repairs often consisted of relining spaces confined within red brickwork or iron castings, the difficulty of bonding had to be overcome by making thick joints. Such brickwork rarely resisted the action of fire like closely jointed work.

From a commercial standpoint, the knowledge of the exact chemical composition of a brick was not sufficient to enable its true value to be determined. The form in which the elements were combined—the size of the particles, that is to say, whether the brick is a coarse brick or a fine brick, etc.—all these factors must be considered. Lastly, a thousand bricks could be bought for the price of one chemical analysis, and therefore it was more often preferred to make a test under working conditions on a bulk sample. A number of each of the two kinds of bricks to be tested should, if possible, be built into one of a pair of furnaces working under similar conditions, and if the same man could act as furnaceman to both furnaces so much the better. Any special strain or harsh treatment to either furnace should be taken strict account of when summing up the relative values of the different bricks.

In testing the single brick, a good plan was to place the whole or half of the brick in the middle of the coke in a crucible furnace at some favourable opportunity—as when the inside was being glazed after re-lining. If the samples withstood the temperature attained under these conditions, it might be regarded as suitable for most general purposes.

Silica bricks must be selected with care and should be of the very best quality. Copper quickly attacked an impure brick, rendering it like a sponge in a very short time. Silica bricks expanded considerably with heat, and allowance must be made for this when a new furnace was built. When heating up a furnace the tie-rods and bracings must be carefully watched and the nuts slackened as required. A non-expanding and non-contracting silica brick had long been sought by users, and a brick which answered all requirements as touching its refractory qualities combined with the advantages already mentioned would be readily taken up. Some non-expansive bricks were used experimentally in the reconstruction of a furnace, and their behaviour under increasing temperatures was all that could be desired. Practically no expansions had taken place when the furnace attained full heat. After only a few weeks' work, however, it was found necessary to shut this furnace down temporarily. The contraction which took place in the bricks on cooling was so great that before the furnace was cold its roof fell in.

Clay crucibles were generally used because of the low first cost, and also because they did not give up carbon to nickel when that metal was melted in them. They required considerable care in warming up, as sudden changes in temperature cracked them. They invariably cracked when allowed to cool, so that at the best a clay crucible would only last for one day's work.

Plumbago crucibles were more expensive in the first place than clay crucibles, but they had a greater heat conductivity and consequently effected a saving in fuel. They did not crack under sudden changes of temperature and might be taken out of the furnace and cooled without suffering damage. One crucible, therefore, would last several days and might be used as long as it would safely hold the metal.

All crucibles, both clay and plumbago, should be stored in a dry warm room and before being put to use should be heated to a temperature above the boiling point of water for at least 12 hours. This would prevent bumping when the pots were first put into the furnaces. The tongs for lifting crucibles out of the furnace should receive careful attention. Crucibles when hot were more or less soft, and badly shaped tongs were liable to distort and break them. The coke for the furnaces should be broken to a proper size before being charged in. Smashing extra large pieces with a poker after the coke had been charged, on purpose to get the coke down round the pots, was a most fruitful source of damage to both crucibles and furnace lining.

Mr. W. J. Rees said that the type of furnace he had been using for very high temperatures, and one which he had not seen anywhere else except in the National Physical Laboratory, to which he supplied one, was made in this way: Take half of what was known in the trade as a tank brick, 15 in. by 15 in. by 12 in., and made of highly refractory clay. A hole should be drilled out large enough to take the crucible, say about 5 in. by 2 in. or 3 in. diameter. He used a Fletcher blowpipe coming into the cavity tangentially. In that way he got the flame to go all the way round. He used coal gas and a Roots blower, and by feeding the jet with oxygen in the place of air with forced draft got an exceedingly high temperature very easily. The brick might be drilled right through and have inserted down the centre a quartz tube made by the syndicate at Newcastle-on-Tyne, and the gases passed through the tube. The brick when bound across with three or four wires lasted a very long time, and with a temperature of 1,600 degrees C. inside the furnace one might put one's hand on the outside without the least fear of burning it. With regard to the superior behaviour of the less refractory bricks, Mr. Page had explained that the important constituent was not the quartz but the matrix in which the quartz was embedded, because this material was sometimes more highly refractory than the quartz grains themselves. They must wait, however, until the work was completed before accepting these investigations as final. There was a great deal to be cleared up in connection with refractory materials. With regard to the Engineering Standards Committee not dealing with the matter, there was a committee in existence, of which he was a member, which was dealing with that and other matters. It was a joint committee on refractory materials representing the English Ceramic Society and the American Ceramic Society, the Society of Chemical Industry, the Gas Engineers, the Iron and Steel Institute, and two or three other national societies in England, on the Continent, and in America. The committee had done some work, but was not doing it very quickly. He supposed the main reason why plumbago bricks were not used was because of their cost, as they compared very unfavourably in price with clay and silica bricks.

Mr. G. B. Wright remarked that Mr. Page touched upon a very important practical point when he said that they were mistaken in regarding a large quantity of silica as indicating very high refractory qualities. That was a mistake many of their practical men shared. Some of the firebrick makers in their analyses were proud to show a very high percentage of silica, and if it was found that silica beyond a certain percentage deteriorated a brick in respect of its practical qualities, it would be interesting to know how high a percentage should be allowed to get the best results. The percentage of alkalis in a firebrick was of the utmost importance

Mr. Rees said that Mr. Wright had put his finger on one of the most important and most debated questions in the firebrick trade to-day. The main reason why the percentage of alkalis was not reported was that the determination was one very difficult to make. He had known analysts in dealing with the same brick make differences of as much as 2 per cent. in their determination of alkalis. In analysing a Stourbridge fireclay, one would give 0.9 and another 2.4. There was no doubt that the best Stourbridge fireclays contained at least 0.9 per cent. of alkalis. Some of the largely used German, French and Belgian fireclays contained even more than that. But the interpretation to be put upon the analysis when the percentage of alkalis was shown depended entirely upon the other constituents. If they had a fireclay containing say 70 per cent. of silica, 20 per cent. of alumina, and 1 per cent. of alkalis, and another containing 60 per cent. of silica and 30 per cent of alumina, the alkalis, though in the same proportion, would have a greater effect in the clay having the higher silica and the lower alumina. There was a very typical case of that in a German fireclay he had used, coming from Saxony, from a place 30 to 40 miles south of Dresden. This contained about 50 per cent. of silica and about 38 to 40 per cent. of alumina, with about 2 per cent. of alkalis, but it actually had a higher refractoriness than a clay which came from a locality not far away from that of the former, and which had about 60 per cent. of silica and 28 to 30 per cent. of alumina, with about 5 per cent of alkalis. But from his own experience, alkalis were dangerous and iron was still more dangerous. Iron in fireclay was a very powerful flux, and Stourbridge clay contained 1 to 1½ and even 3 per cent. of iron. The question of fireclays had not received so much attention in this country as in Germany, where a tremendous amount of work was being done on it and was now available, though we were gradually making up our leeway.

Plaster Blocks for Moulding Machines.

By W. F.

Patterns to be used on moulding machines are generally either cast-iron plate patterns or plaster of Paris blocks. The adaptability of the last-mentioned method is worthy of attention. In the first place, it is not necessary for firms who have adopted hand-ramming machines to discard good iron patterns, as the writer will endeavour to demonstrate. In the making of a plaster block two top flasks or copes are required, interchangeable with the flasks used on the machine, differing from them only in that the flasks for the plaster blocks will require two angle pieces cast in each end, as shown in Figs. 1 and 2. These angle pieces are for the purpose of supporting a strip of iron A, 2 in. wide and ½ in. thick, to strengthen the plaster in the one flask. A similar strip B with two holes slotted in, for the purpose of receiving the pattern pins, is used in the second flask.

Taking as an example a pattern for an ordinary bearing block, this is placed on a turning-over board, using one of the drags or bottom flasks used on the moulding machine, and rammed up in the usual way, the drag turned over, and the joint made. The pattern is then brushed with a little common machine oil, and a sprig or a piece of wire is inserted in the sand to mark the place where the down runner will be when the block is in use. One of the flasks, as represented in Figs. 1 and 2, is put on, and the strip A is laid in the flask, the two ends resting on the angle pieces. The plaster of Paris is now poured in, and when this has set the flask is lifted off, put on its side, and washed with water to remove all sand that adheres to it. When dry a good coat of shellac should be applied to the surface to be used, to prevent the sand sticking to the block when in use.

Assuming that the dummy block or odd-side is dry, it is put to its first practical use in making the second block that will have to carry the iron pattern. The dummy block is laid on the floor, and the pattern

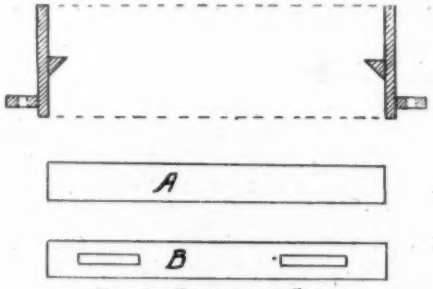


Fig. 1.—Section of Flask.

placed exactly in the impression left in the plaster, it having been previously ascertained that the threads in the taking-out holes have not worn away, as it will be necessary to fasten the pattern to the second block with pins or bolts to the strip B, to make it a fixture. The drag is then put on, rammed up, and turned over, and when the block is lifted off the joint is found to be made. It is not necessary to oil the pattern this time, owing to its being a fixture.

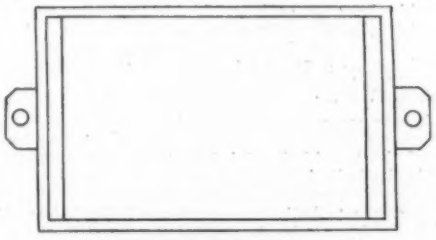


Fig. 2.—Plan of Flask.

The gates are now cut in the sand to enable a *facsimile* to be formed on the pattern block, the second flask is put on, two pins with a thread on each end are screwed into the taking-out holes, the strip B is slipped over them, and nuts screwed on to make them taut. The plaster is then poured in, and, when set, is lifted off and subjected to the same treatment as the first block.

The process of moulding from a plaster block is similar to moulding from an iron plate, except that it is only necessary to put the block with the pattern attached to it on the machine. The other block can be laid on the floor and the top flask rammed up on it in that position, and be lifted off without having to turn over every time. It is obvious that in case of a rush order two men, one working a block on the machine and the other ramming the top flasks off the block on the floor, would greatly facilitate getting an order out quickly.

Foundry Plant and Equipment.

Indicating and Recording Pyrometers.

We illustrate herewith a class of indicating pyrometers for all temperatures up to 1,600 degrees C., and for very low temperatures. These instruments fall into three particular categories:—(1) Instruments for reading temperatures up to 600 degrees C.; (2) those for reading temperatures up to 1,600 degrees C.; and (3) those for reading very low temperatures.

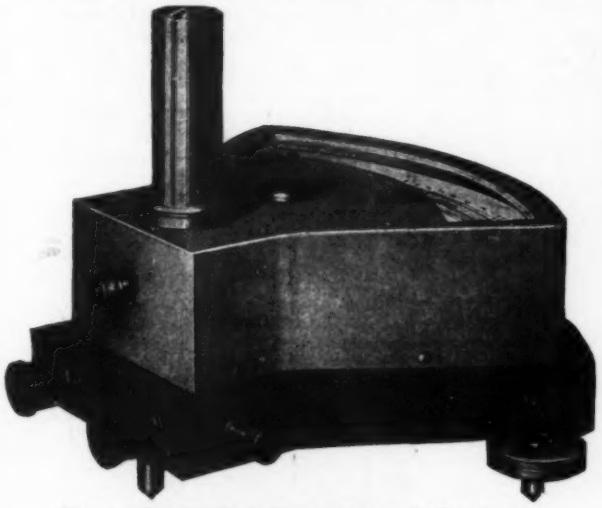


FIG. 1.—LABORATORY PYROMETER WITH LEVEL AND DELICATE SUSPENSIONS.

FIG. 2.—WORKSHOP INSTRUMENT.

The instruments for reading up to 600 degrees C. comprise a thermo-electric couple of iron and constantan, suitably enclosed and protected against oxidation. The thermo-junction is placed in the body whose temperature is to be measured, and is connected by means of ordinary electric light wires to a sensitive galvanometer which is calibrated to read directly in degrees C. or F., as required. The instrument may be placed anywhere at a distance from the thermo-junction itself, and may be of the wall

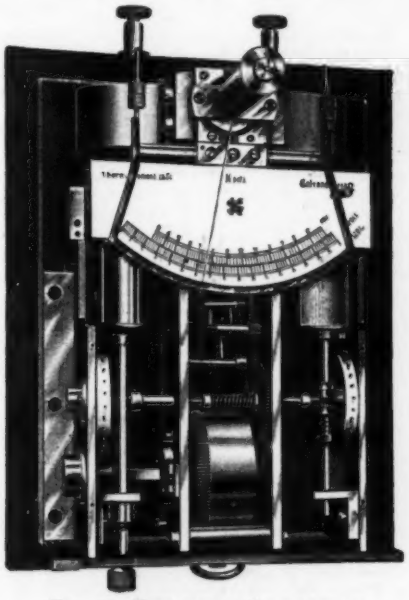


FIG. 3.—RECORDING INSTRUMENT WITH COVER AND PAPER BOTH REMOVED.

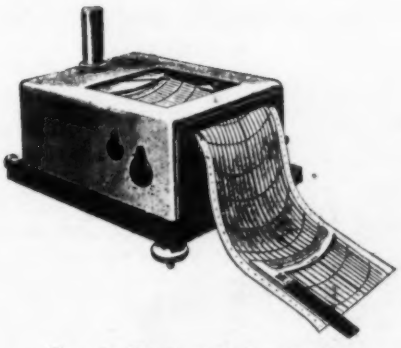


FIG. 4.—RECORDING APPARATUS.

type or may be arranged for lying horizontally on the table, or again the instrument may be portable so that it can be used anywhere. This arrangement is very much used for measuring temperatures of superheated steam in boiler installations, a thermo-junction being permanently fixed in each superheater of a battery, while one instrument suffices to

read the temperature of each superheater in turn.

The second class of instrument is suitable for steel work, smelting, hardening and generally for high-temperature furnace work. A platinum-rhodium thermo-junction is used, together with a highly sensitive galvanometer. The platinum wires are enclosed in double porcelain tubes, which are protected by steel or nickel tubes, or for very high temperatures by means of fire-clay tubes. The galvanometers are arranged for laboratory or workshop use, and a high degree of accuracy is guaranteed. The third class of instrument is suitable for refrigerating work or for very low temperatures, such as that of liquid air. An iron and constantan couple is used with a highly sensitive galvanometer calibrated to ordinary or to the absolute scale.

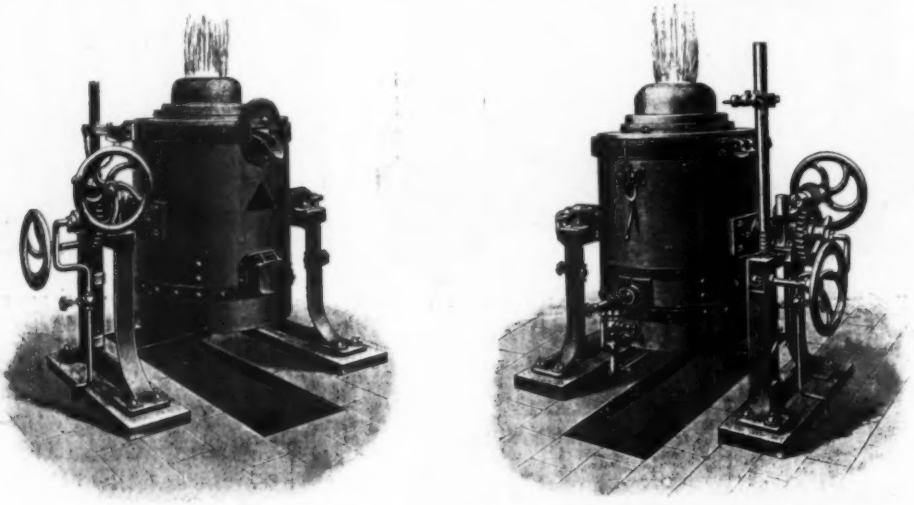
Instead of ordinary indicating galvanometers, a recording instrument can be provided. This consists of a highly sensitive galvanometer which records the temperature curve on a sheet of graduated paper, which is wound off a drum by an eight-day clockwork. These recorders are capable of registering simultaneously the temperature curves from five different thermo-couples on the one record sheet. One great advantage of these recorders is that they provide a continuous check on the proper working of the process in question, in addition to which they form an exact record of the period during which the plant is at work, and of the time during which it is out of action. In all cases where the cold junction is in such a position that the temperature of the surrounding air is above the normal, a suitable compensating device is supplied to eliminate errors.

Fig. 1 shows the design of instrument suited to laboratory requirements, taking temperatures up to 1,600 degrees C. The thermo-junction is platinum-rhodium. Fig. 2 shows a workshop instrument with jewelled suspension, while in Fig. 3 is seen the recording apparatus used with these pyrometers, Fig. 4 showing this instrument with the cover and paper roll removed.

The makers of these instruments are Messrs. Keiser & Schmidt, Berlin, who are represented in this country by Mr. H. I. Lewenz, 6, Trinity Square, London, E.C.

The Buess Oil Furuace.

The Buess oil-fired furnace for melting bronze, brass, copper, nickel, aluminium, etc., consists of a rotary, cylindrical iron casing, lined with fire-proof material so as to leave a central space for the reception of the crucible, which is mounted on a fireclay block. The mixture of oil and air blown into the combustion chamber through a nozzle affixed to the furnace itself, burns with a brilliant white, smokeless flame, which entirely surrounds the crucible. The hot gases escape through an opening in the furnace top, and are advantageously utilised for heating up the charge and the casting ladle. The furnace can be tilted in a very easy manner by means of a worm and worm-wheel gearing. To prevent the furnace bottom from becoming overheated—a contingency otherwise liable to occur—a cooling device is provided, which adds considerably to the working life of the furnace lining. An oil heater is also attached to the furnace, to enable viscous oil to be used and the temperature of the oil to be regulated as desired.



Front and Back Views of the Buess Oil-Fired Furnace.

The burner nozzle atomises the oil completely and gives perfect combustion. The oil consumption can be regulated to a nicety. As the burner, being attached to the furnace, moves with the latter when tilted, the heating of the charge can be continued even while pouring—a feature of special importance in the case of fine castings and special alloys. For the latter, which require to be poured direct from the crucible, the furnace is either fitted with a simple device for lifting out the crucible, or else is made portable so that the whole may be transported to the moulds. This latter form is also suitable where very heavy castings have to be poured. Owing to the manner in which the burner is mounted on the furnace, the entire charge can be run out through a special opening in the bottom of the furnace, in the event of the crucible breaking, and caught without loss. The furnace is made in four sizes, for charges of 1½ cwt. to 10 cwt., and larger sizes can be obtained to order from Mr. Carl Männel, Hannover-Vahrenfeld, Germany, who is the manufacturer.

Inventions.

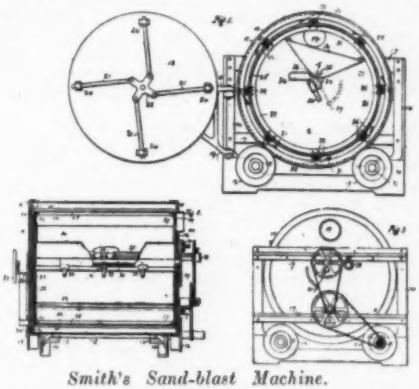
Applications for Patents.

An asterisk indicates that a complete specification accompanies the application. When inventions are communicated the names of the communicators are in brackets.

12,214.*Electric induction smelting furnaces. A. Hiorth, 19, Holborn Viaduct, London.
12,305.*Sand-moulding machines. (Société Anonyme des Etablissements Ph. Bonvillain et E. Ronceray, France.)
12,341. Furnaces. (Charles Thomson, Chili.)
12,492. Manufacture of ingots or masses of steel or steel alloy for use in the production of articles requiring hard wearing faces and soft backing parts. F. E. Matthews, C. A. Pim, and E. H. Strange.
12,498. Process for the removal of scale and oxide from iron and steel surfaces. S. O. Cowper-Coles, 82, Victoria Street, Westminster.
12,653. Apparatus for making cores for valves. J. Naylor.
12,747.*Operation of gas furnaces for heating, scaling, and hardening. Firm Paul Schmidt & Desgraz Technical Bureau G. m. b. H.
13,058 and 13,059. Metallurgical furnaces. V. Stobie, Sheffield Annealing Works, Warren Street, Sheffield.
*13,122. Processes and apparatus for moulding or casting. G. Atterbury, 265, Strand, London.
13,304.*Casting metals of high melting point. A. L. J. Queneau.
13,317.*Oscillating furnace. L. Canda.
13,364.*Portable blast burner for brazing or welding. Fletcher, Russell & Company, Limited, and T. W. Fletcher, 4, St. Ann's Square, Manchester.
13,585 & 13,586.*Four-stroke cycle gas engines. W. Haarmann.
14,412.*Furnaces. J. von Riegin, 37, Furnival Street, Holborn, London.
14,489. Mortar-boxes for stamp-mills. Sandycroft Foundry Company, Limited, and E. J. Williams.
14,510. Furnaces. J. Salessky.
14,520. Manufacture of steel. V. Stobie, Warren Street, Sheffield.
14,630. Ingot moulds. J. Scott, 4, Stanhope Road, Stockton-on-Tees.
14,695. Drying of the cores used in the casting of metals. M. L. Jones, 139, Dale Street, Liverpool.

Abstracts of British Patent Specifications recently accepted.

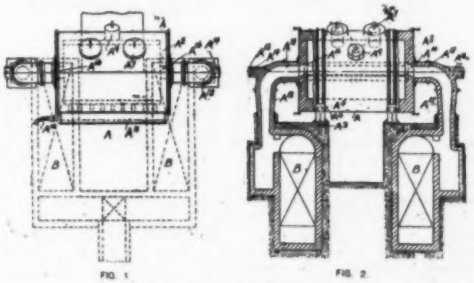
25,134 (1909). *Sand Blast Machines.* W. J. Smith, 1,435, Chapel Street, New Haven, Connecticut, U.S.A.—Figure 1 is a front elevation of a machine in accordance with this invention, the cover being open; Figure 2 is a longitudinal section, partially broken away; and Figure 3 is a rear elevation of the machine. 10 is a drum with end bearings 11, 11, which rest on flanged wheels 12, journalled in bearings 13 in the frame 14, one of the wheels 12 being fast on the driving shaft 15, so that the drum 10 is rotated at the desired speed, the other wheels rotating as idlers. The rear head 16 of the drum is stationary, being riveted to angle irons 17, extending across the end of the frame 14. The front head comprises a door 18 carried by a hinge 19 from one of the uprights of the frame 14. A central trunnion 20 permits the door to rotate with the drum to which it is secured by bolts 21 which are attached at one end to a cam member 22 controlled by the wheel 23 and passing through guides 24, to engage behind the inwardly projecting flange of the bearing ring 11 on the front end of the drum. Within the drum is a removable screen barrel 25, reinforced, both within and without, by channel bars 26, extending lengthwise of the barrel, and by internal angle rings 27 at each end. This screen barrel is provided with a head 28, at the end adjacent the door 18, but is open at the other end to permit the ready charging and discharging of the castings, when the screen barrel is removed from the drum. The external channel bars 26 engage with guide bars 29 on the inner face of the drum, which guide bars act, not only as guides on the insertion and withdrawal of the screen barrel, but also serve to impart to the barrel rotary motion from the drum. Extending inwardly from, and carried by, the stationary head 16 of the drum, is the sand trough, or hopper 30, into which, during the operation of the machine, the sand which



Smith's Sand-blast Machine.

has been used is continually discharged by the scoops 31 on the drum. Passages 32 open from this trough into the blast nozzles 33 connected with the compressed air pipe 34. A stirrer 35 driven from the shaft 15 not only prevents the sand from "caking" in the bottom of the trough 30, but also distributes the sand evenly to the blast nozzles, while a valve 36, provided with a handle 37, controls the amount of sand supplied to the nozzles. A valve 38 is provided in the air pipe. To permit the escape of dust, a hole 39 with pipe flange 40 is opened through the upper portion of the stationary head 16.

11,863 (1909). *Furnaces for Treating Metals and Metalliferous Ores.* E. T. Fennell, 5 and 6, Church Street, Woolwich, Kent; and J. Sackett, 11, Woodland Terrace, Charlton.—Fig. 1 is a plan view of the furnace, regenerators and their accessories constructed in accordance with the invention; Fig. 2 is a part sectional view of the furnace, partly in section. A designates a cylindrical shaped furnace-body which is constructed of mild steel plates, riveted together and suitably stayed, the

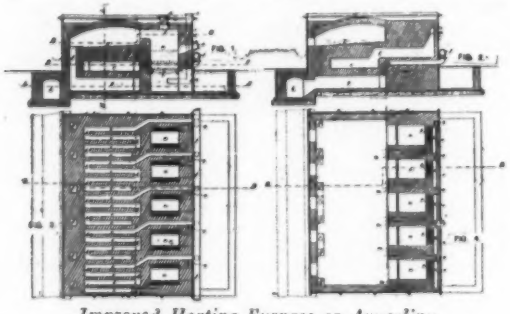


Furnace for Treating Metals and Metalliferous Ores.

ends consisting of plates suitably strengthened at the rim and centre, which plates are fastened to the circumferential shell by means of spring washer bolts. The structure as a whole is suitably supported on foundations A^3, which are provided with rollers A^4 arranged to run in the roller track A^5, which track serves also to strengthen the shell. The clamped refractory lined lids A^7 of the refractory shoot or orifice A^8 are utilised for charging the hearth. The tuyeres A^{10} are connected

to the blast box A^{11}, which is suitably connected to the shell and supplied with a cold or hot blast from the flexible pipe A^{13} or its equivalent. The regenerators B of Siemens or other suitable design are connected to the furnace by means of the refractory lined pipes A^{12}, which alternately convey the hot blast to, and the waste gases from, the furnace. The lined pipes A^{12} are entered laterally by the pipes A^{14} provided with valves A^{15}, which pipes supply liquid or gaseous fuel when required. The flame or blast delivered from alternate ends of the furnace enters through the inclined orifices A^{16}, and is directed upwards when the furnace-body A is in its normal position. The refractory lining A^2 is preferably thicker in the hearth than the roof, and the abutting portion or slope A^{17} directs the transverse blast, and also serves to protect somewhat the nozzle or delivery part of the tuyeres A^{10} from the molten metal.

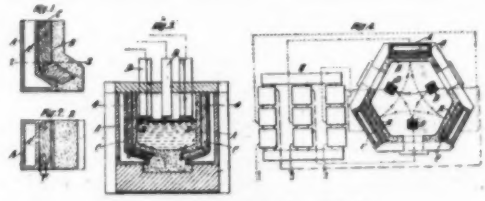
12,710 (1909). *Heating Furnaces, Annealing Furnaces, Etc.* W. Kirkham, Wood Street, Sheffield.—Fig. 1 is a sectional elevation taken on the line A—B, Fig. 4; Fig. 2 is a sectional elevation taken on the line C—D, Fig. 3; Fig. 3 is a plan in section taken on the line E—F, Fig. 1; Fig. 4 is a plan in section taken on the line G—H, Fig. 1. The fuel is placed into the gas producer *a*, through an opening *b*, with coal hopper *c*, attached, and also through an opening *d*, in the front part of the producer. The gases from the producer, after receiving heated air, pass along the bed of the furnace *e* to the far end, then down vertical flues *f*, into a series of horizontal flues *g*, which extend the full length of furnace bed *e*. From these flues *g*, the waste heat finally goes into the chimney flue *h*, or stack. Between the bed of the furnace *e* and the horizontal flues *g* a series of horizontal air flues *i* are arranged, which receive air from a conduit *j* outside the furnace at the gas producer end, of either natural draught or forced draught by means of a fan, steam jet or similar device. The air then passes along a flue within the wall



Improved Heating Furnace or Annealing Furnace.

of the producer *a* at the front into the series of horizontal air flues *i*. These horizontal hot air flues *i* are arranged with division walls *k* between same so that the hot air travels along one flue *i*, back along another flue *i*, then into another flue *i*, and in like manner until the hot air is taken up a sloping flue *l* within the wall *m*, between the producers *a*. Thence it flows into a flue *n*, arranged within the wall *o* at end of top portion of the producer. The hot air then passes through outlets or perforated bricks *p*, formed in the brickwork of producer chamber *a*, and so over the heated gases in same causing better combustion and greater heat. From this point the heat then passes over the bed of furnace *e* to the far end of same, then down vertical flues *f*, into horizontal flues *g*, previously described (and which are below the horizontal hot air flues *i*), and finally to the chimney flue *h*.

26,266 (1909). *Electric Furnaces.* J. Härden. The Grondal Kjellin Company, Limited, 20, Abchurch Lane, London, E.C.—Figure 1 is a vertical section, and Figure 2 a horizontal section on the line 2—2 of Figure 1, of one form of the improved terminal plate. Figure 3 is a vertical section, and Figure 4 a horizontal section on the line 4—4 of Figure 3 showing the application of the invention to a three-phase furnace. The terminal plates, one or more of which are embedded in the wall of a direct-current or alternating-current furnace, each comprise the metal plate A, the refractory facing B, and the intermediate layer of carbonaceous material C. The metal plate A is of cast steel, and is formed with one or more cavities or channels A^1 in which air or other cooling medium is circulated. The intermediate layer C may consist of graphite or other suitable carbonaceous material mixed with a suitable binding material and rammed into position, or it may be prepared after the manner of preparing carbon arc electrodes and be shaped before being placed in position. Owing to the interposition of the comparatively good electric conducting carbonaceous layer between the refractory facing and the hollow metal plate, the refractory facing B may be heated to a much higher temperature than it could safely be heated to if it were in immediate contact with the metal plate, and the refractory material employed is therefore preferably such as is capable of withstanding an intense heat; chromite, or zirconite, is useful for this purpose. When employing these terminal plates in any furnace employing



Electric Furnace, by Härden.

electric arcs, large quantities of steel may be efficiently treated and the majority of the heat may be developed by means of the terminal plates, the arcs being employed merely to ensure a satisfactory desulphurisation and dephosphorisation of the steel. By reason of the low resistance of the molten metal in the furnace compared with the resistance of the refractory material B, and owing to the narrowness of the portion of the material B facing the layer C compared with the resistance between the electrodes as measured through the material B, no appreciable current passes through the base of the furnace, but nearly all of it passes direct through the metal in the furnace from one electrode to the other. The three-phase current furnace shown in Figure 3 is provided with three terminal plates. The three electrodes D, D, D of the three electric arcs, and the three terminal plates, are connected to a three-phase transformer E. The terminal plates are preferably connected and arranged so as to be capable of being used independently of the arc electrodes.

20,372 (1909). *Manufacture of Castings.* Hobbies, Limited, 12, Paternoster Square, London, E.C.; and H. Jewson, East Dereham.—A cast-iron mould, made up of two or more parts, is employed, the lower portion of the mould being water-cooled, while the upper portion of the mould is of such form, and is so secured to the lower portion, as to be capable of being rapidly removed from contact with the casting. Into this mould the molten metal is poured, and as soon as the upper surface of the casting has solidified, and whilst still red hot, the upper portion of the mould is removed, and the top of the casting is allowed to cool exposed to the atmosphere. The result is to produce castings in which the bottom surface is glass hard, whilst the upper surface is remarkably tough and strong. The process described is specially applicable to the production of plough shares, and similar castings, the lower portions of which are required to resist wear, whilst the upper portions must be sufficiently strong to resist shock and prevent breakage, but must wear away somewhat more quickly than the bottom, thus always maintaining a sharp cutting edge.

Correspondence.

The Use of Moulding Machines.

To the Editor of the FOUNDRY TRADE JOURNAL.

DEAR SIR,—Your contributor "R.C." in his remarks on "Moulding Machines in the Jobbing Foundry," raises the important question as to why these machines are not in more general use. That they are essential to the economical production of castings has been proved for 25 years, but there still remains the same old prejudice against them. Naturally a foreman shirks them, as unskilled labour is required to work them.

The moulder himself has nothing good to say about them, he believes they are doing him out of a job; but machinery cannot be given brains, and however automatic they may be, there will always be required in the foundry the skilled craftsman.

Sir Joseph Whitworth, in his days, remarked, that our national prosperity was in proportion to the increase of self-acting machines we kept at work, and if we are to keep pace with the times it is an absolute necessity to pass in the foundry labour-saving machinery, and encourage suggestions that have as their object the cheapening of the production of castings.

Our apathy has allowed our foreign rivals to take advantage of us, and we need only to visit those foundries using moulding machines to get the disagreeable impression that what should have been supplied by British manufacturers have been imported from foreign countries. Such names as Tabor, Pridmore, etc., are quite common and well known in our foundries.

Readers of your valuable journal must have noticed that the majority of moulding machines described from time to time have been by foreign makers.

Had we, in the past, been more alive to the possibilities of moulding machinery, we should at least have been in a position to meet our own demands, and have probably created a demand from other countries for our machines in place of having to import foreign machinery.

Yours truly,
"J. R. M."

Queries and Replies.

Castings of Copper.

I am often required to cast ingots of copper 2 in. long by 3½ in. round from ingots of pure copper. They are then taken to the forge and put under a steam hammer, and hammered out 4 ft. long. Some have turned out well, others have given fairly good results, but all show signs of cracking. We have tried them both cold and hot, but with the same results. They have to be machined bright all over after hammering. "R. W."

Answer.—Granted that the copper is correctly treated in the hands of the forgers, the presumption is that the cracking in question results from the presence of some amount of oxide of copper in the castings. This oxide would probably be formed during the process of melting, and unless means were taken to clear it, would remain in the metal, as copper is very liable to absorb its own oxide instead of sending it to the surface as a scum. To ensure getting clean metal it is advisable to employ during melting either silicon or magnesium. If the former, an alloy of copper 90 per cent. and silicon 10 per cent., should be first made, and 1 lb. of this alloy added to 100 lbs. of the copper to be melted. If it is preferred to employ magnesium, 2 ozs. to 100 lbs. of copper should be introduced into the molten copper by pushing it under the surface with the tongs. The whole should then be thoroughly stirred at once. It need scarcely be said that the metal must be melted under a good covering of charcoal to protect it from oxidation. The pot should be sufficiently large to easily accommodate the metal to be melted as well as the charcoal, for if it be too full the protective carbon monoxide which is formed from the charcoal will be lost, and the metal endangered.

Trade Talk.

MESSRS. MOSES & NAYLOR have established a foundry at Ossett, Yorkshire.

MESSRS. WATSON & WHITTAM, engineers, Kirkstall Road, Leeds, are reported to be giving up business.

WE understand that Mr. M. Timmins, ironfounder, Wellington Road, Dudley, proposes to relinquish business.

MR. G. SAVILLE, engineering valuer, etc., has removed from 37, Moorfields, Liverpool, to 45A, Market Street, Manchester.

MESSRS. J. MARTIN and E. Foster, Southport, trading under the style of Martin & Foster, engineers, have dissolved partnership.

UNITED BRASSFOUNDERS AND ENGINEERS, LIMITED, have removed their head office to Empress Foundry, Cornbrook, Manchester.

MESSRS. J. JAMIESON and J. G. JAMIESON have started business as engineers at Kirkgate, Alloa, under the style of Jamieson Brothers.

MESSRS. A. RILEY and T. G. MANNING, engineers, etc., Oldham, trading under the style of Arnold Riley & Company, have dissolved partnership.

A DISSOLUTION of partnership is notified by Messrs. J. Rawson and J. T. Clarke, engineers, Tunbridge Wells, trading under the style of Clarke & Rawson.

MESSRS. B. TURNER and D. TURNER, tool manufacturers, Sheffield, trading under the style of Abram Brooksbank & Company, have dissolved partnership.

MESSRS. DOUGLAS & GRANT, of Kirkaldy, N.B., have acquired the sole British rights for the drop valve steam engines made by Messrs. Carels Frères, Ghent.

M. CANON-LEGRAND, of Mons, Belgium, has appointed Mr. H. Enthoven, Danes Inn House, 265, Strand, London, W.C., as his sole British and Colonial agent.

MESSRS. P. A. BICKET and T. CHADWICK, Manchester, trading under the style of the Acme Governor Engineering Company, notify a dissolution of partnership.

MR. G. G. POPPLETON, of 26, Corporation Street, Birmingham, ceased to act as receiver or manager of the Hurst Iron Works Company, Limited, on April 11 last.

THE NATIONAL STEEL FOUNDRY, LIMITED, are converting the works at Kirkland, Methil, Fifeshire, recently occupied by the Cyanide Company, into steel casting works.

HADFIELD'S STEEL FOUNDRY CO., LIMITED, have secured an order from the Launceston City Council for the supply of points and crossings, etc., to the value of £2,300.

DARGUE, GRIFFITHS & COMPANY, LIMITED, have removed their London office to 34, Queen Anne's Chambers, Westminster, S.W., with Mr. Wilson Aldwinckle as their London agent.

L. GARDNER & SONS, LIMITED, Barton Hill Engine Works, Patricroft, near Manchester, are making extensive additions to their commercial offices, fronting on Gordon Street.

Mr. R. C. Cook, 3, St. Nicholas' Buildings, Newcastle-on-Tyne, has lately been appointed agent for the following firms:—Hartmann's Anti-Corrosive Paints; Metallic Manufacturing Company, Limited, Ardrossan; and Wm. Ross & Sons, Thistle Street, Glasgow.

Mr. W. P. Butterfield, of the Galvanising Works, Shipley, Yorks, has converted his concern into a private limited company, with a capital of £30,000. The style of the firm is to be W. P. Butterfield, Limited, with Mr. W. P. Butterfield as sole managing director.

Owing to the death of Mr. William Lord, the late proprietor, the Lord Street Boiler Works, Bury, have been shut down. John Musgrave & Sons, Limited, have purchased the goodwill, the plant and fixtures are being disposed of privately and the works are offered for sale.

The Lilybank Foundry of the Caledon Shipbuilding and Engineering Company, Limited, Dundee, was the scene on June 5th last of what threatened to be a serious outbreak of fire. The fire brigade was, however, promptly summoned, and the flames were subdued before serious damage had been done.

The premises of the Mining and Metallurgical Club were formally opened by the President, Mr. Sidney Farrar, on May 30. The inaugural dinner and smoking concert, provisionally fixed for May 31, has been postponed in consequence of the lamented death of King Edward. The date will be announced later.

Mather & Platt, Limited, are practically doubling the available floor space at their Park Works, Newton Heath, Manchester, by the erection of an additional two bays, each 400 ft. long by 38 ft. wide, the present works having been found wholly insufficient to deal with the electrical portion of the company's productions.

The new locomotive erecting shop at the works of Nasmyth, Wilson & Company, Limited, Bridgewater Foundry, Patricroft, Manchester, is nearing completion. The equipment of the older shop has been found inadequate for coping with the increased demand for the heavier types of locomotives and this shop will eventually be given over to general machine work.

Greenwood & Batley, Limited, Albion Works, Armley Road, Leeds, are introducing into this country the Bonvillain patent universal system of machine moulding, of which they are the sole manufacturers in Great Britain and over-seas dominions. The company recently made with this system special mechanical spiral gear plates for the making of worm and spiral gears for gas engines, which gears are impossible to cast in any other way.

Messrs. Appleton & Howard, St. Helen's, Lancashire, have recently laid down a new moulding shop and a new machine shop at their Salisbury Street Works, and have adopted electrical driving throughout. Every foot of available space at the present works is now utilised to the best advantage, but the firm are experiencing some difficulty in keeping the output up to demand, and are considering the erection of a new work at an early date.

A specially appointed Committee of the British Iron Trade Association, among whom were the President, the Rt. Hon. Sir Charles McLaren (Chairman), Lord Glantawe, Sir Thomas Wrightson, Mr. George Hatton, and the Secretary (Mr. C. J. Fairfax Scott), met on June 10, at the Westminster Palace Hotel, to consider the Japanese, Swedish, and Australian tariffs on iron and steel, and a communication was directed to be sent to the Foreign Office and the Board of Trade pointing out in what directions the Association desired modifications in the tariffs.

Tilghman's Patent Sand Blast Company, Limited, Broadheath, near Manchester, have this year received orders from the following firms for plant:—Glasgow Cycle Company, Glasgow; Chas. H. Day Manufacturing Company, Limited, London; London General Omnibus Company, Walthamstow Garage; Wycliffe Foundry Company, Limited, Lutterworth; J. A. Phillips & Company, Birmingham; Braintree Castings Company, Braintree; Steel Company of Scotland, Glasgow; W. Shaw & Company, Limited, Middlesbrough; Planet Foundry Company, Limited, Guide Bridge; Woodhouse & Company, Limited, Doncaster; Barr & Strouds Patents, Glasgow; and J. B. Petter & Sons, Limited, Yeovil.

Despite the announcement made a short time back that the difficulties which threatened the existence of the Scottish Steel Makers' Association had been smoothed out, there are still some outstanding matters which seriously imperil the continuance of the combination. Among these are an apportionment among makers of plates of a certain proportion of all boiler plate specifications that come into the local market, the declaration of a stated period over which contracts with buyers should run, and the naming of a given quantity of material for which producers shall be at liberty from time to time to contract. These proposals have raised considerable opposition, and at the moment it is practically impossible to find a solution of the difficulty.

An important reform is at present under the consideration of the Scottish Ironmasters' Association. For years a practice has prevailed of allowing buyers considerable latitude in the matter of taking up their contracts for material, with the result, it is alleged, that consumers are encouraged to enter into highly speculative transactions, which are often detrimental to the interests of producers. It is now proposed that all future contracts shall run for stated periods of three or six months, and that material for which specifications have not been received at the due dates shall be charged 1s. 3d. per ton per month more. By those means it is hoped not only to bring buyers to a better realisation of their responsibilities, but to place a check on undue speculation.

Steam has now been entirely dispensed with at Messrs. John Varley & Company's Waterloo Foundry, St. Helens, Lancashire. The foundry floor is served by five cranes (15, 5, and 2 tons), the whole being electrical in all motions. The tumbling wheels and emery wheels are driven from line shafting operated by a motor. The cupola charger is operated by an electrically-driven winch, and the Baker blower is coupled direct to a Crossley 30-h.p. gas engine. A 15-h.p. gas engine by the same makers drives a car type disintegrator and the mixing mill. In the machine shop the small machines are driven from line shafting, taking motion from a gas engine, and the larger machines are independently motor-driven. Power for the pattern shop is supplied by a motor through line shafting.

Justices Bray and Coleridge, in the Divisional Court of the King's Bench Division last month, gave an interesting decision regarding the posting of dividend warrants. In February, 1909, the Great Northern Railway Company, the defendants, posted to Mr. Thairluall, solicitor, the plaintiff, dividend warrants for interest on stocks he held. The warrants were lost, and the company refused to issue duplicates, except the shareholder signed an indemnity. This he refused to do, and was upheld in the Clerkenwell County Court. Last month their lordships reversed the decision of the lower court, allowing the appeal without costs. They held that the railway company had discharged their liability by sending the dividend warrant, and that the plaintiff could only get payment by giving a proper indemnity to the company.

The establishment of local sections of the Institute of Metals having been sanctioned by the Council at a meeting held in London on April 27, a meeting was held at the Grand Hotel, Birmingham, on Thursday, June 16, to consider the advisability of forming a local section for Birmingham and district. Mr. G. A. Boeddicker presided. A letter of apology for absence was read from Sir Gerard Muntz, President of the Institute. The chairman explained that the establishment of local sections was sanctioned by the Council at a meeting held in London in April, and he urged that by taking advantage of that provision a section could be formed which would be of very great educative value to the members. Meetings, he suggested, could be held frequently, when papers might be read, and matters of professional interest discussed. On Mr. Boeddicker's

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proposal, seconded by Professor Turner, it was decided to send a petition to the Institute asking for sanction to form a local section, and a Committee, with Mr. G. G. Poppleton as hon. secretary, were appointed to make the necessary arrangements.

In the Companies' Winding-up Court, recently, Mr. Justice Neville had before him a petition by Mather & Platt, Limited, for the compulsory winding-up of Moorwood, Sons & Company, Limited, ironworkers, of Sheffield. Counsel in opening the petition, stated that the petitioners were creditors for £75 in respect of goods supplied, and they had obtained judgment. It was suggested in opposition that the majority of the creditors thought it was for their good that there should be no liquidation at all. What the company had done was, on January 11, to appoint a receiver on behalf of the first mortgage debenture holders. The petitioners had no objection to him, but he was now an officer of the Court, and he was the nominee of Mr. Duffield, a gentleman largely interested in the company. It was proposed to solve the difficulty by means of a re-construction scheme or an amalgamation. It was suggested that that was the best thing for all parties concerned. In a statement put out by the Receiver as to the company's position, it would appear that the assets were £90,287; the liabilities on the first debentures £26,000, with interest; on the second debentures £12,000 and interest; the overdraft to the bank and sundry creditors, £14,674. That showed that there would be a surplus of assets over liabilities, after all the creditors had been paid, of nearly £20,000. The evidence showed that there were creditors for nearly £15,000, and the only liquid asset was cash in hand, £31. Last year's balance-sheet showed a loss of £9,000, and so far as could be ascertained there was every reason to believe that the business was still being carried on at a loss. His Lordship, remarking that they wanted to see what was done in the way of realising the assets, ordered the petition to stand over until the last petition day before the Long Vacation.

Personal.

Sir David Gill, K.C.B., has been elected president of the Institute of Marine Engineers.

Engineer-Lieutenant H. C. Anstey, R.N., has been appointed to the post of Inspector General of Machinery of the Chilian Navy.

The late Mr. W. E. Everitt, deputy-chairman of Allen Everitt & Sons, Limited, left estate valued at £103,995 gross, with net personalty £76,809.

Mr. A. F. Halstead has succeeded the late Mr. A. H. Hoy as manager of the works of Beyer, Peacock & Company, Limited. Mr. Halstead was previously secretary of the firm.

Mr. F. W. Harbord has been retained by the Canadian Department of Mines to investigate and report on recently invented processes in Europe for the production of spelter and zinc oxide.

Mr. Wilson Worsdell, chief mechanical engineer of the North-Eastern Railway Company, who is retiring after 27 years' service, has been the recipient of a presentation from the workmen in Gateshead.

Mr. G. B. Waterhouse, who has been engaged on work in metallography and other special lines, for the Lackawanna Steel Company, Buffalo, U.S.A., in the past few years, has been appointed metallurgist of the company.

The late Mr. Charles Emmot, chairman of the Blake Boiler, Wagon and Engineering Company, Limited, and Robert Stephenson & Company, Limited, and a director of Richard Hill & Company, Limited, left estate valued at £24,500 gross.

The late Mr. Arthur Greenwood, of the firm of Greenwood & Batley, Limited, and a director of the Iron Trades Employers' Insurance Association, Limited, Power and Traction, Limited, Chairman of the Horsfall Destructor Company, Limited, King's Norton Metal Company, Limited, and the Russian Engineering Company, Limited, left property valued at £20,555, with £8,135 net personalty.

Mr. Horace Marr, lately foreman moulder in the foundry department of Messrs. John Wright & Eagle Range, Limited, Birmingham, recently left that position to become foundry foreman at the Yew Tree Foundry, Hollingwood, Lancashire. As a mark of esteem, his colleagues in the foundry department presented Mr. Marr with a gold watch suitably inscribed. Mr. James Grant, the foundry manager, presiding over the workmen's meeting, expressed his regret at the departure of Mr. Marr, remarking that he had never worked with a more consistent and genial foreman. He sincerely wished him every success in his new sphere. Mr. C. Heggie, of the pattern department, who was also the Secretary of the Birmingham Branch of the British Foundrymen's Association, and Mr. Evans, of the same department, spoke in complimentary terms. The recipient thanked them heartily for their handsome gift, which he said would be highly prized.

Deaths.

The death is announced of Mr. E. Eastwood, wagon builder, of Chesterfield, Nottingham, etc. in his 84th year.

Mr. J. W. Maud, of Messrs. Maud & Turner, machine tool makers, Gibbet Street, Halifax, died recently, aged 64 years.

Mr. H. A. Hoy, general manager to Beyer, Peacock & Company, Limited, Gorton Foundry, Manchester, died recently.

Mr. J. Holland, of Messrs. J. Holland & Company, engineers, Strangeways, Manchester, died recently aged 56 years.

The death is announced of Carl Röchling, the senior director of the Röchlings Iron and Steel Works, which he founded 30 years ago. He was 83 years of age.

The death is announced of Mr. James Stott, general manager to Wm. Dawson & Sons (Otley), Limited, of the Ashfield Foundry, Otley, which took place at his residence, Ashfield Place, Otley, on the morning of May 28. Mr. Stott was in his 62nd year.

The death is announced of Mr. A. Henrik Goransson, which took place last week, in his 68th year. The deceased gentleman was chairman and managing director of the Sandvik Iron Works Company, Sandviken, Sweden, and had been for some time past engaged on a Royal Commission of enquiry into the tariffs of Sweden. He was also President of the Chamber of Commerce in Gefle, and had frequently been consulted upon commercial matters by the late King of Sweden. Under the directorship of the late Mr. Goransson, the Sandvik Works have increased enormously during the last few years. The plant has been extended by the addition of new rolling mills and steel furnaces of the latest type.

New Companies.

Cecil Hodges & Company, Limited.—Capital £1,000 in £1 shares, to carry on the business of electricians, engineers, etc.

Dustfoe, Limited.—Capital £5,000 in £1 shares, to carry on the business of ironfounders, etc. Registered office: 44, Stanley Street, Southport.

Dynes Bros., Limited.—Capital £1,000 in £1 shares, to carry on the business of agricultural, mechanical and electrical engineers and repairers, etc.

T. E. Morgan & Company, Limited.—Capital £100 in £1 shares, to carry on the business of gas, electrical, mechanical and general engineers, etc.

Scott & Sangwin, Limited.—Capital £1,000 in £1 shares (960 A Ordinary and 40 B Ordinary), to carry on

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The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blowholes and other defects, than we formerly did.

From BOW, McLACHLAN & CO., LTD. (Paisley Foundry), Paisley, Glasgow.

Paisley, 12th March, 1909.

We have yours of 4th inst., and in reply have pleasure in stating that we have been using your Foundry Coke for several years for special purposes with highly satisfactory results.

Elders Navigation Collieries, Ltd., Cardiff.

the business of patent owners, engineers, boilermakers, founders, &c.

KEIGHLEY FOUNDRY COMPANY, LIMITED.—Capital £1,000 in £1 shares, to carry on the business of iron and brassfounders, etc. Registered office: Greengate Foundry, Keighley.

RUDKIN ENGINEERING COMPANY, LIMITED.—Capital £1,000 in £1 shares, to take over the business of the W. R. Mudd Refill Company, engineers and machinists, Charles Street, Leicester.

T. & W. GARNER, LIMITED.—Capital £7,000 in £1 shares, to acquire the business of T. & W. Garner, Witham Road, Skelmersdale, and to carry on the business of ironfounders, etc.

MARGRAM FORGE, LIMITED.—Capital £5,000 in £1 shares, to carry on the business of founders, engineers, etc., and to adopt an agreement with M. C. Jenkins and J. H. Morris. Registered office: Port Talbot, Glamorganshire.

MORTON GAS SYNDICATE, LIMITED.—Capital £10,000 in £1 shares, to carry on the business of general engineers, etc., and to adopt an agreement with G. L. Morton. Registered office: Hyde Junction Iron Works, Hyde, Cheshire.

YULE'S PATENTS, LIMITED.—Capital £750 in £1 shares, to acquire the business of J. S. Yule & Company, 57-58, Chancery Lane, W.C., and to carry on the business of ironfounders, etc. Registered office: 5, Idol Lane, Eastcheap, E.C.

A. SEWARD & COMPANY, LIMITED.—Capital £10,000 in £1 shares, to acquire the business of a heating and ventilating engineer, etc., carried on by Mr. C. F. Seward as A. Seward & Company, at Market Street and Sun Street, Lancaster.

WHITTINGTON WELDING COMPANY, LIMITED.—Capital £2,000 in £1 shares, to take over the business of the Whittington Welding Company, and to adopt an agreement with W. H. Nichols. Registered office: 16, Hazelville Road, Upper Holloway, London, N.

BRIGHTEN, MALCOLM & KING, LIMITED.—Capital £25,000 in £1 shares, to take over the business of engineers and contractors carried on by Brighten, Malcolm & Company, Limited, at Shanghai. Registered Office: 16, St. Helen's Place, London, E.C.

G. & A. MENZIES, LIMITED.—Capital £2,000 in £1 shares (600 5 per cent. cumulative preference), to take over the business carried on at Chester Road, Manchester, as G. & A. Menzies, and to carry on the business of ironmasters. Registered office: Chester Road, Manchester.

WRIGHT, ANDERSON & COMPANY, LIMITED.—Capital £6,000 in £1 shares (1,000 preference), to carry on the business of structural and general engineers, founders, and merchants, etc, and to adopt an agreement with J. Wright and W. J. Anderson, trading at Abot Street, Gateshead, as Wright, Anderson & Company.

CANADIAN-AMERICAN MACHINERY COMPANY, LIMITED.—Capital £3,500 in £1 shares, to carry on the business of machinery manufacturers, etc., and to acquire that part of the undertaking of the Toronto Type Foundry Company, Limited, known as the Canadian-American Machinery Company. Registered office: 8, Bouverie Street, E.C.

LAKE & ELLIOT, LIMITED.—Capital £20,000 in £1 shares (10,000 6 per cent. cumulative preference), to carry on the business of engineers, etc., as formerly carried on by W. B. Lake and E. F. Elliot at Albion Works, Bocking, as Lake & Elliot, and at Chapel Hill, Braintree, as the Braintree Castings Company. Registered office: Albion Works, Rayne Road, Bocking, Essex.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years:—

METALS.	End June, 1910.	End June, 1909.
Iron—Scotch pig warrants ton	.....*55/3	.....*54/3
—Middlesbro' warrants . ton	.....49/3	.....48 6
—W.C. M/nos Bessemer ... ton	.....67 6	.....58 6
—Stock, Scotch ... ..tons	1,000	1,000
Copper—Chili bars, GMB ton	.....£55 2 6	.....£39 10,0
—Stock, Europe and afloat tons	.....‡105,371	.....‡62,261
Tin—English ingots ... ton	.....£147 10,0	.....£127 0,0
—Straits ... ... ton	.....£148 5 0	.....£125 10,0
—Stock, London, Holland, U.S.A., and afloat ...tons	..... —	14,705
Lead—English pig ... ton	.....£13 2 6	.....£13 0,0
Spelter—Ord. Silesian ... ton	.....£22 0 0	.....£18 17 6
Quicksilver (75lb)... bottle	....£8 15 0	£7 17,6—£8 0 0
Antimony—Regulus .. ton	£29 10,0-£30 10,0	.... £34 0,0

* Settlement price. † June 15. ‡ June 15.

CASTINGS.

In the Cleveland district the following are the nominal rates current for castings:—

	£ s. d.		£ s. d.
Columns (plain)	6 10 0	to	6 15 0
Pipes, 1¼ to 2½ in.	4 17 6	to	5 2 6
,, 3 to 4 in.	4 10 0	to	5 0 0
,, 5 to 8 in.	4 7 6	to	4 10 0
,, 10 to 16 in.	4 7 6	to	4 10 0
,, 18 to 24 in.	4 7 6	to	4 10 0
Chairs	3 10 0	to	3 12 6
Floor plates (open sand)	3 0 0	to	3 5 3

SCRAP.

The quotations for scrap, subject to market fluctuations, are as follows:—Heavy wrought (mixed), £2 10s. 0d.; light wrought, £1 7s. 6d.; heavy cast, £2 8s. 0d.; all per ton f.o.b., London. Copper (clean), £53 0s. 0d.; brass (clean), £38 10s. 0d.; lead (usual draft), £12 0s. 0d.; tea lead, £11 0s. 0d.; zinc, £18 0s. 0d.; all per ton delivered merchant's yard.

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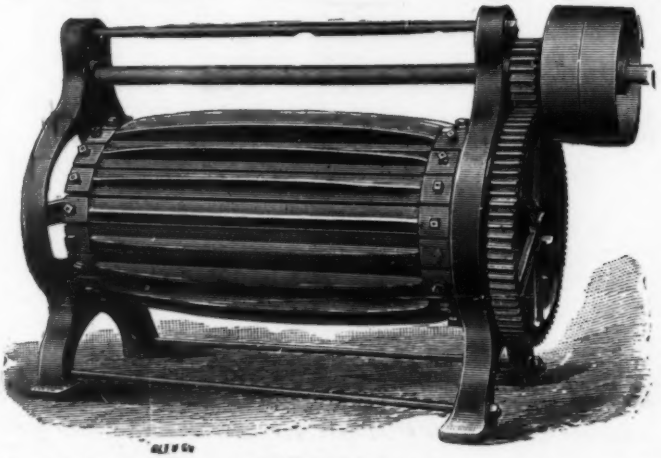

These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD."

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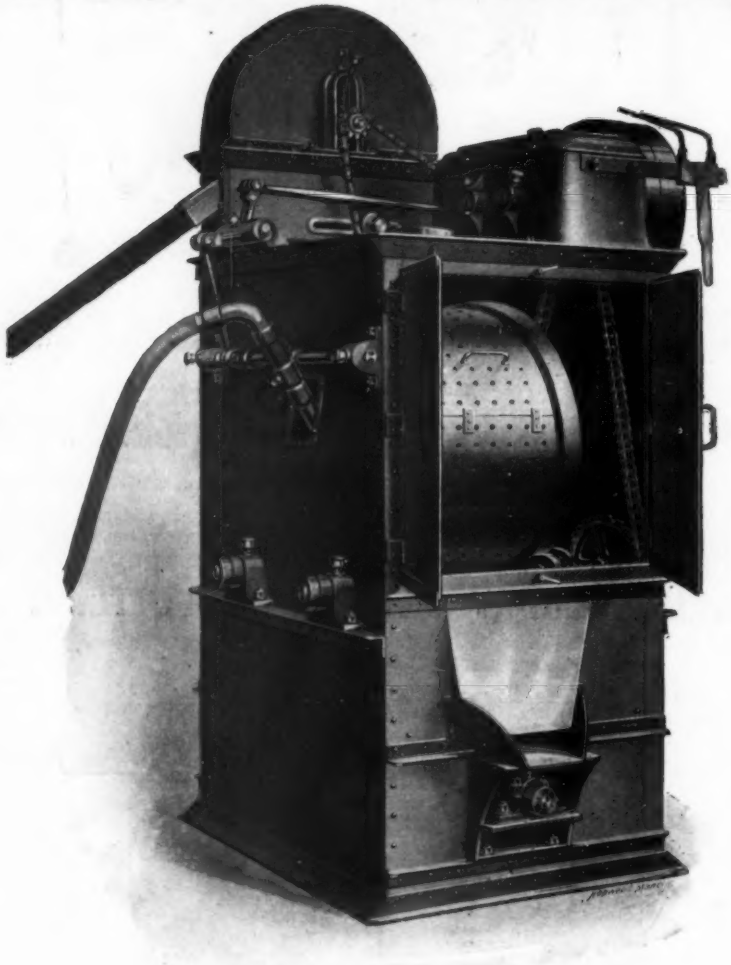

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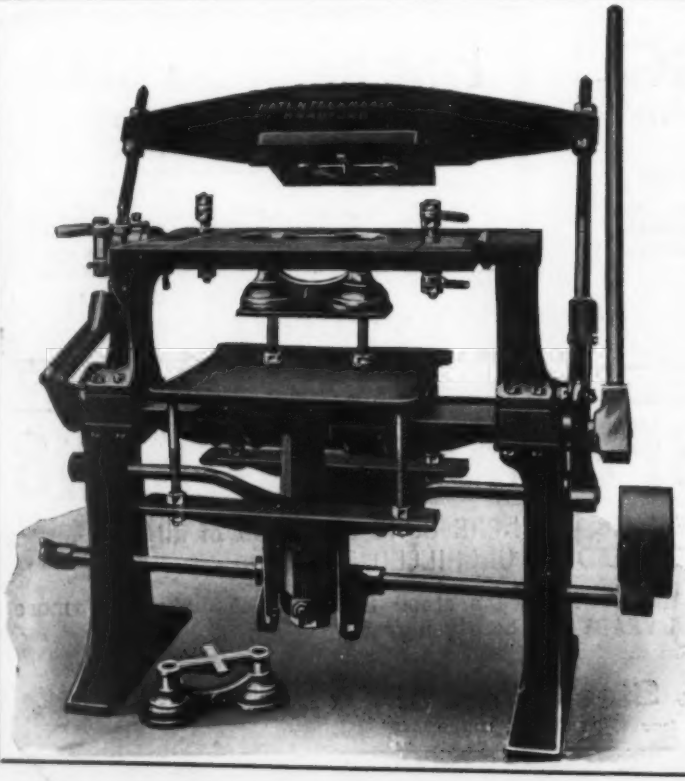

The accompanying illustration shows the Pickles' Patent Moulding Machine used with a stripping plate, and half the pattern being withdrawn through the plate, and half being from the top of the mould, this being the centre part of a 3-parted . . mould. . .

For full particulars apply to Patentee :: and Sole Maker. ::

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	Marshall, H. P., & Co.	Core Machines	Leeds	Specialty, Leeds ...	1909 Leeds
396	McNeil, Chas.	Steel Ladles	Kinning Park, Glasgow	McNeil, Glasgow ...	X 155
447	Olsen, William	Plumbago and Blacking ...	Cogan Street, Hull	—	—
396	Phillips, Chas. D.	Foundry Core Ovens ...	Newport, Monmouthshire ...	Machinery, Newport ...	18 & P.O. 576
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C. iii.	Plasti-Kion Co., The	Iron Cement	Caxton House, S.W.	—	—
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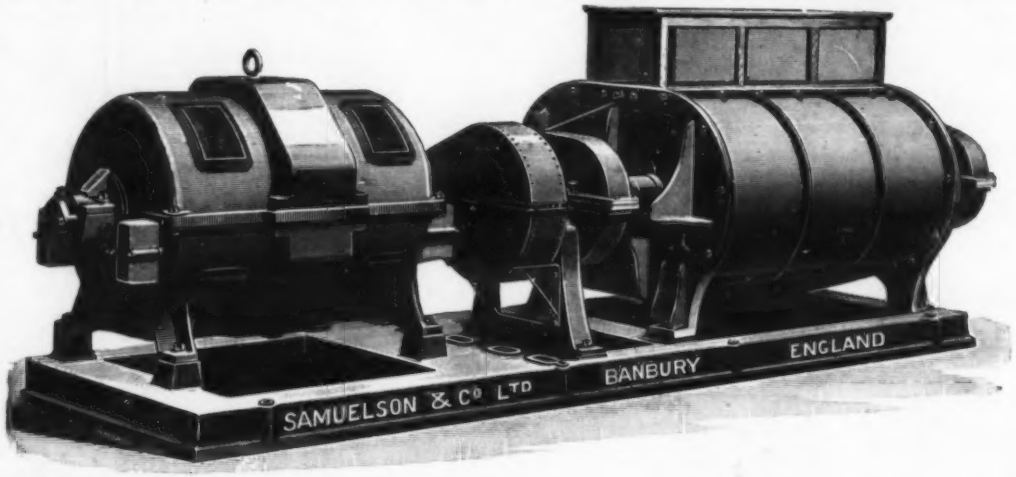

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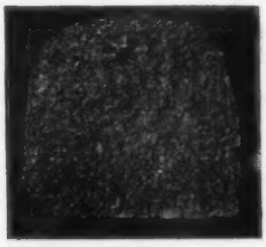
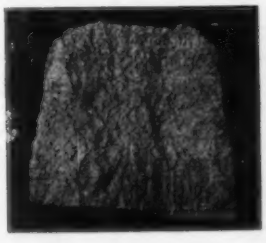
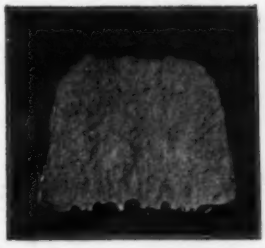

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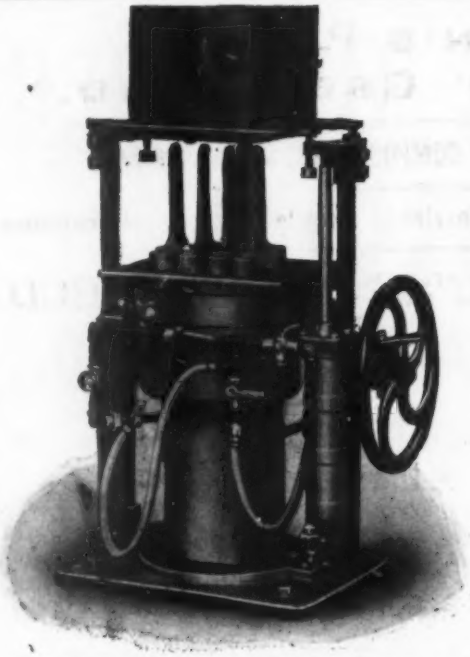

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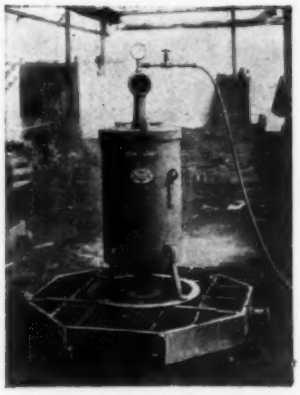

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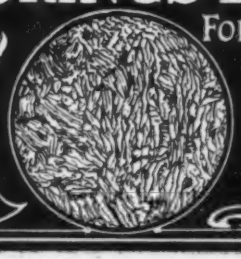

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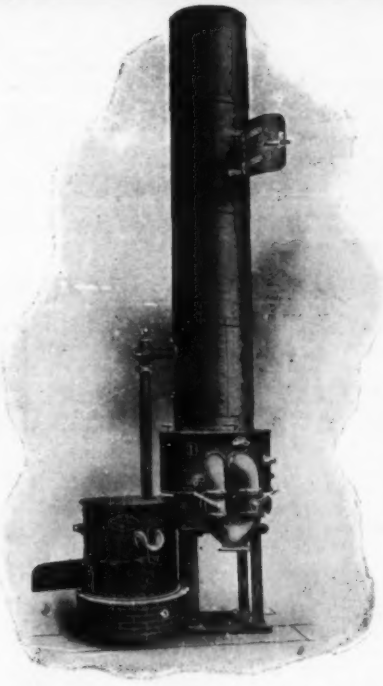

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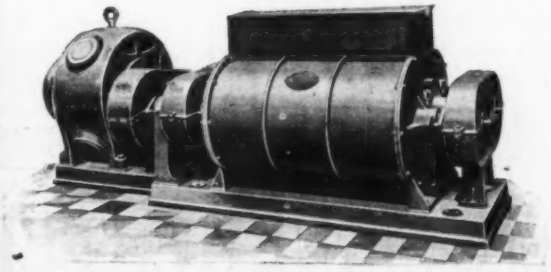

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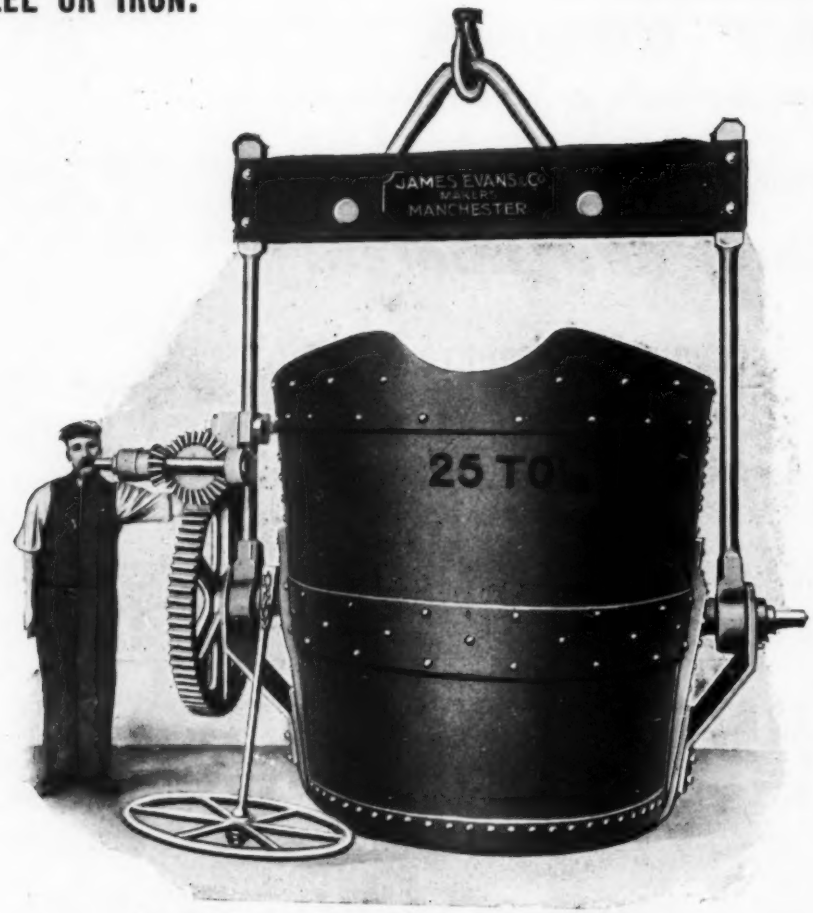

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